Water Plant Optimization Study

TOWN OF DESERONTO
WATER TREATMENT PLANT

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WATER PLANT OPTIMIZATION STUDY

TOWN OF DESERONTO
WATER TREATMENT PLANT

Project No. 7-2046

Report prepared for:
Drinking Water Section
Water Resources Branch
Ontario Ministry of the Environment

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in association with
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INTRODUCTION

The Ontario Ministry of the Environment (MOE) has established a Drinking Water Surveillance Program (DWSP) for the purpose of providing an up to date database of the quality of drinking water from Ontario Water Treatment Plants (WTPs). In conjunction with DWSP, a specific plant investigation and process and operational evaluation is required for each water treatment plant involved in the program. Consequently, the MOE sponsored "Water Treatment Plant Optimization Studies" are being undertaken for each WTP in order to document the existing water quality, to define the present unit processes and operating conditions and to determine an optimum treatment strategy for contaminant removal at the plant. Specifically, emphasis has been placed on the particulate removal and disinfection efficiency of the water treatment plant.

A detailed Protocol for the WTP Optimization Studies has been prepared by MOE. The "Deseronto WTP Optimization Study" has been prepared in accordance with the Protocol.

This report presents the Deseronto WTP raw water quality data, describes the unit treatment processes and outlines present plant operating methodologies. This information was used to evaluate the current particulate removal, disinfection, taste and odour control and pH control practices and to establish the modifications necessary to optimize plant performance.

The report has been organized into the following 6 sections:

Section A: Raw Water Source

This section presents the historical physical, chemical and biological quality data for the raw water.

Section B: Flow Measurement

Methods of measuring plant flows are presented in this section.

Section C: Process Components

This section contains descriptions of all of the process components at the plant.

Section D: Plant Operation

This section presents the details of present plant operating practices, both in general terms and with respect to each of the process components.

Section E: Plant Performance

This section reviews the plant performance of each of the various processes and presents recommendations for process optimization.

Section F: Summary of Recommendations

This section presents a summary of all recommendations, broken down into three categories: operational changes, capital expenditures and studies.

In addition, Appendices are included which contain historical (1985-1987) water quality data, particulate removal profiles, disinfection summaries and DWSP (1987-1988) analytical results from the Deseronto WTP.

A. RAW WATER

A.1 SOURCE

The Town of Deseronto receives its water from Lake Ontario's Bay of Quinte. An intake system is situated about 0.5 km from the shore, 6 m below the surface of the Bay. Figure A-1 shows a map of the WTP and intake locations.

The Deseronto Water Treatment Plant (WTP) intake is located downstream of two municipal water pollution control plants (WPCPs) (Belleville and Trenton WPCPs) and 5 major industrial point source load contributors: Bakelite Thermosets Ltd. (Belleville), Corby Distilleries Ltd. (Belleville), Domtar Chemicals Group - Wood Preserving Division (Trenton), Domtar Packaging - Containerboard Division (Trenton), Paperboard Industries Corporation - Trent Valley Paperboard Mills Division (Trenton). With the exception of the two Domtar plants, these industries are not known to discharge any priority pollutants. Domtar Chemicals discharge both pentachlorophenols (PCPs) and phenols. Domtar Packaging also discharges phenols. Contaminant loadings from these upstream industries are not expected to have an impact on the raw water quality at Deseronto WPCP. The Deseronto WPCP, located adjacent to the treatment plant, discharges 200 m downstream of the raw water intake pipe.

A.2 QUALITY

Treatability studies performed before the plant was designed showed that Bay water coagulates readily and produces a strong floc with good settling characteristics. Due to a prolific algae bloom during the summer months, Bay of Quinte water has an extremely high taste and odour level. Threshold odour numbers of 400 or higher have been measured.

Appendix I, Table I-1 presents a summary of the raw water quality for the years 1985 to 1987, based on measurements recorded at the plant. Also presented, in Table I-2 are highlights of seasonal variations for these parameters. Table I-3 presents the available 1988 MOE Drinking Water Surveillance Program (DWSP) results.

The physical and chemical characteristics of the raw water are presented in Table A-1.

There are no marked seasonal patterns in raw water colour levels. Raw water turbidity levels seem to have been relatively higher in July to October in all years. This is expected, as a result of warm weather algal blooms, rainfall runoff contributions, etc. On an annual basis the turbidity levels tended to follow a decreasing pattern from 1985-1987. Alkalinity and hardness concentrations, based on the available data, are fairly constant. DWSP analytical results for hazardous contaminants (metals and organic compounds) presented in Table I-3 show that the concentrations of all HCs never exceeded the Ontario Drinking Water Objectives (Ref. 1), and most compounds on the DWSP list were never detected above the DWSP method detection limits (MDL).

Figure A-1
MAP SHOWING DESERONTO WTP LOCATION

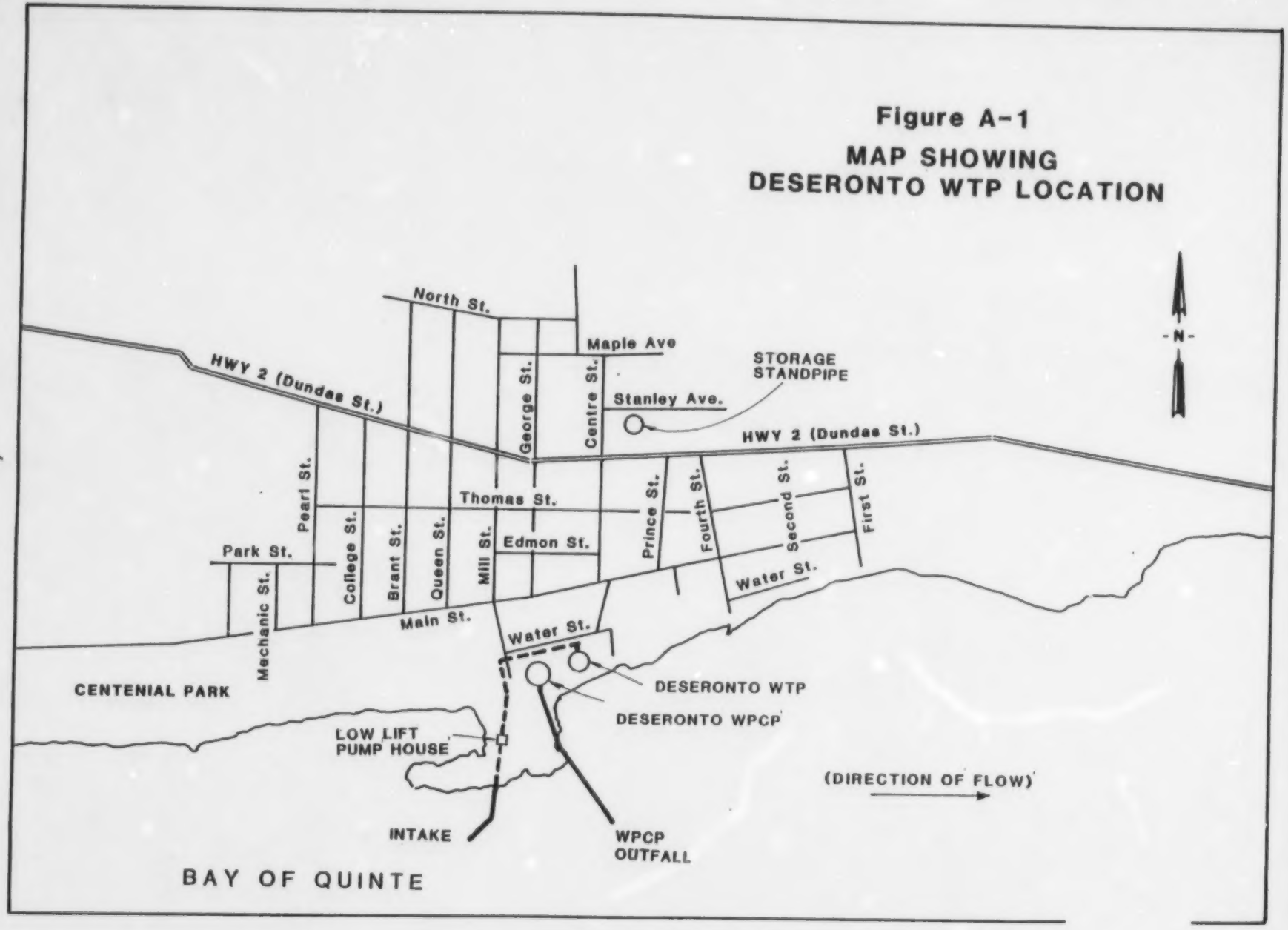


Table A-1 PHYSICAL AND CHEMICAL CHARACTERISTICS OF RAW WATER		
Parameter	**In-plant Monitoring (1985-1987)**	**DWSP (1988)**
Turbidity (field) (FTU)	1.0 - 17	0.9 - 6.9
Colour (TCU)	<5 - >70	12.0 - 23.5
Temperature (°C)	2 - 27	1 - 26
pH (field)	6.95 - 8.50	7.5 - 8.3
Alkalinity (mg/L as $CaCO_3$)	*	94.0 - 115.3
Hardness (mg/L as $CaCO_3$)	*	108 - 136
Aluminum (µg/L)	*	19 - 136
* Not measured onsite at the Deseronto WTP.		

The bacteriological test results from 1985 to 1987 based on weekly sampling and analyses at the Kingston Regional MOE are presented in Table II-1. Table II-2 presents the DWSP bacteriological results for the raw water for 1988.

The bacteriological raw water quality results are presented in Table A-2.

Table A-2 BACTERIOLOGICAL CHARACTERISTICS OF RAW WATER		
Bacteria	**1985 - 1987**	**DWSP (1987-1988)**
Total Coliform	90% of samples: 6-100 CFU/100 mL 10% of samples: >101 CFU/100 mL	- 2-1100 CFU/100 mL
Fecal Coliform	90% of samples: 6-100 CFU/100 mL 10% of samples: >11 CFU/100 mL	0-12 CFU/100 mL

B. FLOW MEASUREMENT

Table B-1 summarized the flow measuring devices at the Deseronto WTP.

Table B-1
FLOW METERING EQUIPMENT

Service	Type/Range	Location	Instrumentation
Raw Water	B.I.F. Venturi Meter (range 0-5000 m^3/d)	Influent pipe before pre-chlorination and sampling line	- Indicator (range 0-5000 m^3/d) - Mechanical cam totalizer (m^3) - Timed pulse transmitter (range 0-5000 m^3/d)
Treated Water	B.I.F. Venturi Meter (range 0-5000 m^3/d)	Distribution system main	- Mechanical cam totalizer (m^3) - Timed pulse transmitter (range 0-5000 m^3/d) - Circular chart recorder-weekly

The raw water and treated water flow volumes are recorded daily. Flow meters are calibrated annually by the MOE Technical Services Unit. Neither meter has required significant adjustment in recent years. Based on the available information, it appears that the historical flow data is fairly accurate.

In order to establish chemical dosage rates, to determine filter efficiency, and to ensure the accuracy of the flow meters, all of the flows must be accounted for. Based on mass balance, the difference between raw water and treated water daily flow volumes is equal to the daily wastewater flow volume discharged from the WTP. The following methods have been used in the past to estimate the wastewater flow volumes, in order to confirm that measured flow volumes are accurate.

- The wastewater flow volume is equal to the estimated daily dual media filter backwash wastewater volume, GAC contactor backwash wastewater volume and the clarifier sludge volume wasted. This method provides good results (i.e. all flows are accounted for).

- An hour meter connected to the waste sump pump records daily hours of pump operation. Based on the rated pump capacity, a total volume of wastewater flow can be calculated. The plant Supervisor has found that this method is very approximate, since the nominal pump capacity is unknown. A flow meter has been requested in order to monitor the wastewater pumping rate.

An estimated volume of 21.0 m^3 per sand/anthracite filter per backwash is assumed. This volume is multiplied by the number of backwashes each day, as recorded on a backwash frequency counter to find the total daily volume estimate.

The GAC contactor backwash waste water volume is estimated by the change in water level in the wastewater equalization tank over the period of backwashing. This volume varies from 10 to 20 percent of the equalization tank volume, or 15.8 to 31.6 m}, depending on the backwash cycle length.

The clarifier sludge volume is wasted for a timed interval, usually between 70 and 100 seconds. The frequency of desludging can be set between 0-2 hours, and occurs only during low lift pump operation. A counter records the frequency of desludging. The desludging flow rate is estimated at 45 L/s.

C. PROCESS COMPONENTS

C.1 GENERAL

The Deseronto Water Treatment Plant (WTP) is located on the north shore of the Bay of Quinte. The plant, designed by L.S. Love and Associates in Brampton, Ontario, was built in 1979/80 and it presently supplies water to a population of about 2000 in the Town of Deseronto and the nearby Tyendinaga Indian Reserve.

The plant treats the Bay water with the following processes: coagulation, flocculation, sedimentation, rapid filtration, granular activated carbon adsorption, final pH adjustment for control of distribution system corrosion, and final disinfection. A pre-chlorination system exists but has not been used since 1986. The coagulation process uses liquid alum as the primary coagulant and a commercial polyelectrolyte as the coagulant aid. The coagulation, flocculation and sedimentation processes all take place in a package reactor clarifier. Figure C-1 presents a process flow diagram for the plant, Figures C-2 and C-3 show a schematic of the plant piping and a summary of process design parameters for the plant.

The plant operates intermittently and automatically. The low lift pumps which pump water through the treatment process start up when there is a low water level in the treated water clearwells, and shut off when the water level reaches a high water level in the clearwells. A Robertshaw level detection probe measures the clearwell water level.

The clearwell water level is dependent on high lift pump operation. High lift pumps are controlled by the level of water in the Town's distribution system storage stand pipe, as indicated by B.I.F. pressure transmitter in the stand pipe tied to a receiver at the WTP.

Depending on the amount of water demanded by the Town, the plant may operate for intervals of one half hour to 3 or more hours. However, when in operation, the raw water is pumped at a constant rate through the treatment system.

C.2 DESIGN DATA

C.2.a Capacity

The Deseronto Water Treatment Plant is designed to treat water at a constant rate of 2.95 ML/day (0.12 ML/h), based on raw water flow rates, for up to 24 hours per day. Plant operation is intermittent, but during the hours of operation, water is pumped through the plant at a constant rate of 0.12 ML/h (the rated capacity). The plant has historically operated 8 to 24 hours per day.

There are 3 low lift pumps at the plant, each with a rated capacity of 1.47 ML/d. During normal plant operation, two of these pumps send raw water through the treatment process, leaving one available for standby maintenance and repair. At the Deseronto WTP, the firm capacity is equal to the rated design capacity of 2.95 ML/d.

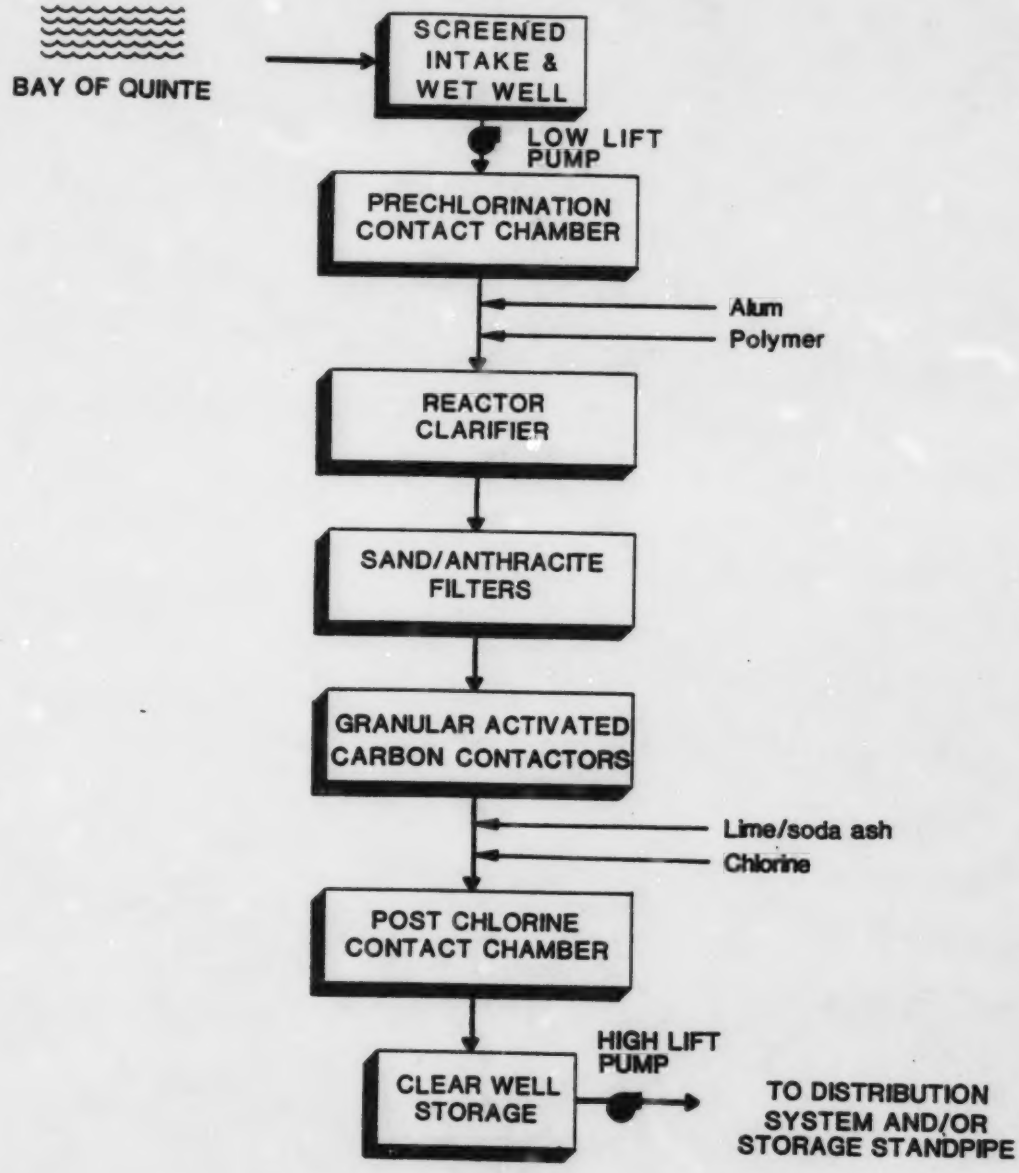
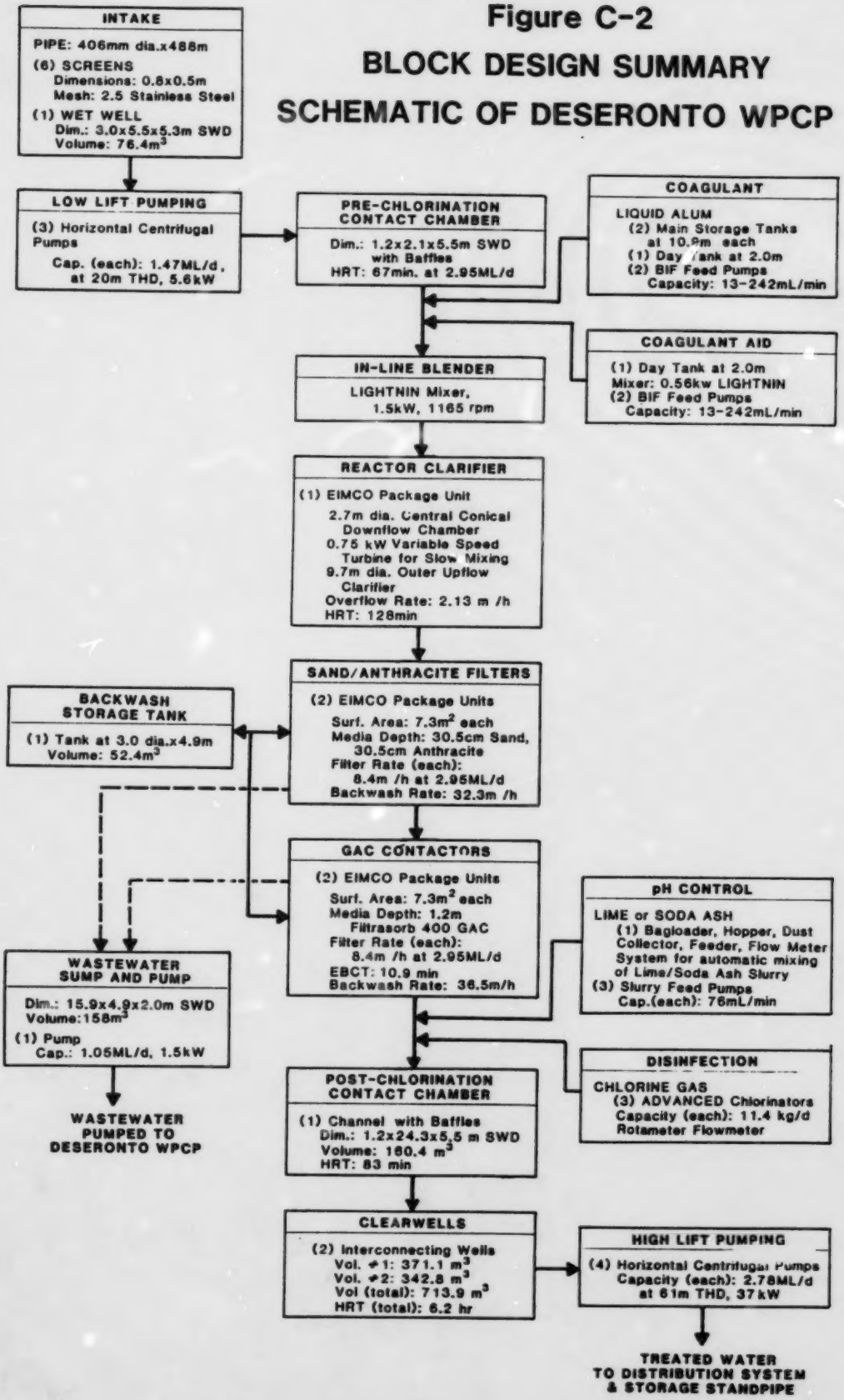


Figure C-1

DESERONTO WATER TREATMENT PLANT

PROCESS FLOW SCHEMATIC

Figure C-2
BLOCK DESIGN SUMMARY
SCHEMATIC OF DESERONTO WPCP



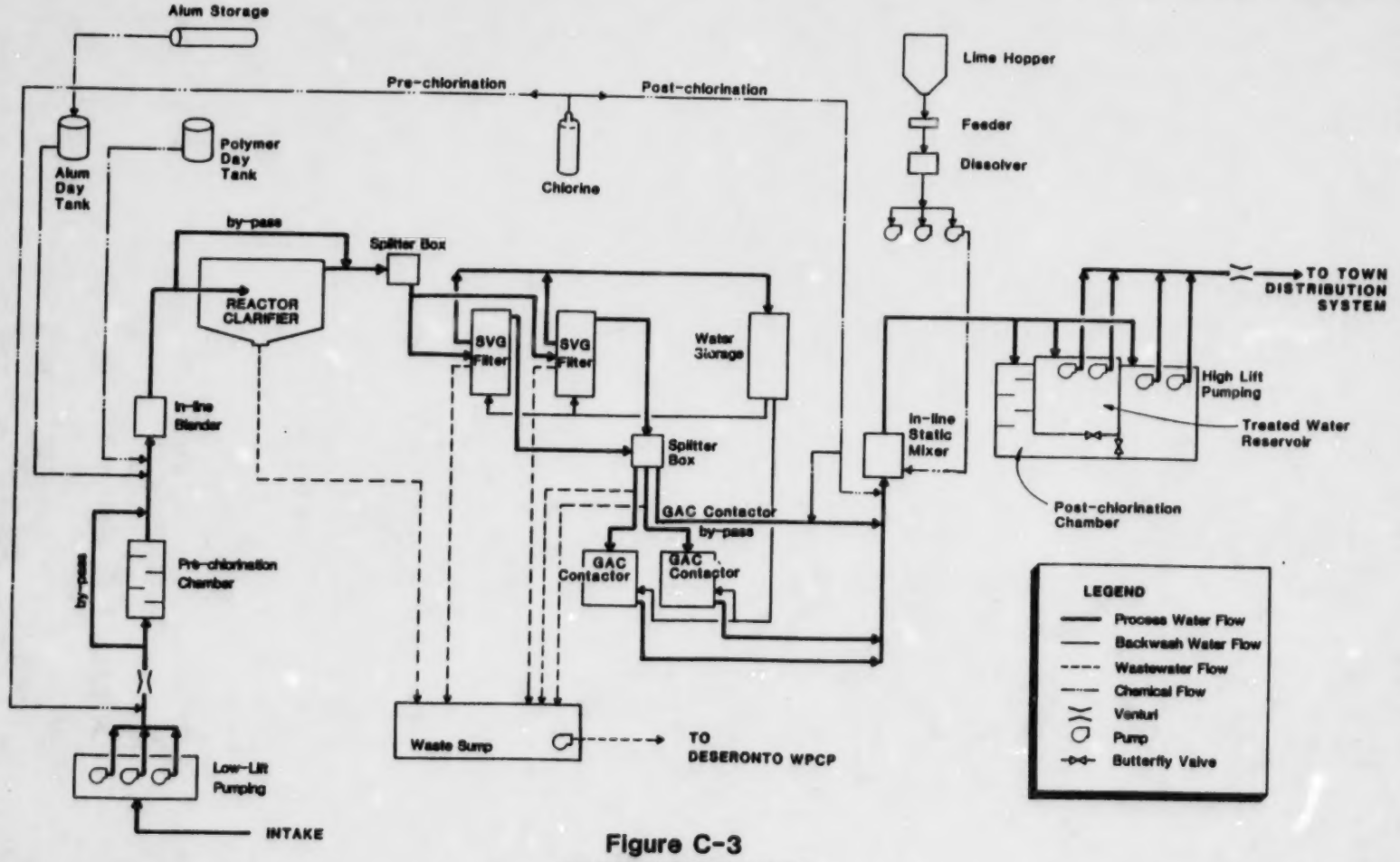


Figure C-3
DESERONTO WTP
PIPING AND PROCESS DIAGRAM

Appendix III presents the maximum, minimum and average daily flows for raw and treated water for 1985-1987. The daily raw water flows for the years 1985 to 1987 have varied from 1.03 ML/d to 2.95 ML/d or from 35 to 100 percent of plant design capacity. Typical flows average 1.80 ML/d, or 61 percent of design flow for summer months (June-August) and 1.30 ML/d or 44 percent of design flow for the remaining months.

C.3 PROCESS COMPONENT INVENTORY

C.3.a Intake

The intake system consists of an intake crib, flanged inlet, pipe and a wet well located in the low lift pumphouse. The system was designed to be shared with Metcalfe Foods of Canada Ltd., a large food processing firm located close to the pumphouse. The maximum design flow for the intake system is 12.4 ML/day, consisting of 5.9 ML/day for the plant and 6.5 ML/day for Metcalfe Foods. Metcalfe Foods ceased operation in 1986 and the intake system is presently used solely by the water treatment plant.

Raw water from the Bay of Quinte is conveyed to the low lift pumphouse via 488 m of 406 mm diameter polyethylene pipe. A 1.5 m diameter stainless steel intake flange reduces to the diameter of the intake pipe. An intake crib consists of 9.5 mm diameter, 0.76 m high stainless steel rods welded at 133 mm spacing around the 1.5 m diameter flange, at a depth of about 6 m below the water surface.

The intake pipe was designed to maintain a maximum flow of 12.4 ML/day based on the lowest water level recorded for the Bay. The intake velocities in the pipe based on the various design capacities are listed in Table C-1. The present operating velocity of 0.26 m/s in the intake pipe compares favourably to a maximum velocity of 0.93 m/s based on MOE Guidelines (Ref. 2) for an intake design using the Hazen Williams coefficient equal to 100 (C=100). There is no in-place device for backwashing the intake pipe.

Table C-1
INTAKE PIPE VELOCITIES FOR VARIOUS FLOWS

Flow (ML/day)	Description	Velocity (m/s)
12.40	Maximum design capacity	1.11
5.90	Maximum intake design - Metcalfe Foods not in operation	0.53
4.42	Maximum WTP capability with all low lift pumps in operation	0.39
2.95	Current WTP capacity	0.26

The concrete intake wet well is 3.05 m by 5.49 m with 5.33 m SWD, and holds a maximum water volume of 76.7 m^3 for no flow conditions and a maximum water level in the Bay.

C.3.b Screening

Raw water passes through six screens upon entering the intake well. Each rectangular screen is 0.77 m x 0.48 m, resulting in a total surface area for all screens of 2.23 m^2. Each screen is 2.5 mesh, 4.8 mm stainless steel rods. The flow velocity through the screens at the rated capacity is 0.06 m/s. This velocity falls well below the MOE maximum velocity Guideline (Ref. 2) of 0.9 m/s.

C.3.c Low Lift Pumping

Three low lift pumps are located in the pumphouse, and discharge to the water treatment plant through 427 m of 254 mm diameter polyethylene pipe. Each pump has the following specifications:

Type:	Horizontal, centrifugal, dry pit, flooded suction
Material:	Cast iron
Manufacturer:	Smart Turner Hayward
Capacity:	1.47 ML/day
TDH:	19.8 m
Motor:	Westinghouse, electric
Size:	5.6 kW
Rotational Speed:	1800 rpm

The plant operators have found that the actual flow output of each pump is greater than the rated capacity. In order to reduce the flow rate to 1.47 ML/day, the pumps are throttled by a butterfly valve in the pipe that leads to the pre-chlorination chamber.

C.3.d Pre-Chlorine Contact Chamber

Raw water is pumped from the low lift pumphouse and enters the water treatment plant and into a pre-chlorination contact chamber. The chamber is a 21 m long channel, 1.2 m wide with 5.5 m SWD and 0.6 m baffles spaced at 2.1 m on alternating sidewalls. The total volume of the chamber is 138.7 m^3, resulting in a hydraulic retention time of 67 minutes at the constant plant flow rate of 2.95 ML/d.

The chlorine application point is located in the raw water pipeline after the raw water flow meter. At present, pre-chlorination is not practised at the plant. However, raw water flows were pre-chlorinated until August, 1986.

A 254 mm diameter bypass pipe exists to enable bypassing of the pre-chlorine contact chamber. Raw water is presently still routed through the pre-chlorination chamber.

C.3.e Rapid Mixing

An in-line blender is located in the 254 mm diameter raw water pipe about 2 m after coagulant addition. Coagulant aid is added into the in-line blender. The pipe enters the reactor clarifier about 18 m after the blender. Plate C-1 shows the in-line blender. The in-line blender has the following characteristics:

Mixer:	LIGHTNIN
Motor:	Tamper, made by Canron Ltd., electric
Power:	1.5 kW
Rotational Speed:	1165 rpm

The in-line blender has not been used at the plant since 1984. Plant staff found no apparent degradation in clarifier performance when it was discontinued. Turbulent mixing of alum and polymer is presently achieved with five 90° bends in the 254 mm diameter pipe between the chemical application points and the entrance into the reactor clarifier. Based on the distance from the chemical application points to the clarifier, the nominal retention time for rapid mixing is 27 seconds.

The energy gradient (G) can be calculated using the following equation (Ref. 3):

$$G = \sqrt{\frac{P}{\mu v}} \qquad \text{(Eq. C-1)}$$

Where P = Power input
μ = Viscosity of water
v = Volume of mixing zone

And $P = Q\gamma H_f$

Where: Q = flow
q = Specific weight of water
H_f = Head loss through pipe

The above equation was calculated assuming that the mixing zone is the entire volume of pipe between chemical addition and entrance into the reactor. The head loss was calculated from the following equation:

$$H_f = f_1 \frac{L}{D} \frac{v^2}{2g}$$

Where: f_1 = Darc Wiesbach friction factor
L = equivalent length of pipe of mixing zone, including 5 - 90° bends
D = pipe diameter
v = mean velocity in the pipe

The G and Gt values for flash mixing at the Deseronto WTP was calculated for the maximum and minimum temperatures of water treated at the plant. These are:

Temperature	G (s^{-1})	Gt (dimensionless)
1°C	110	2970
26°C	157	4239

Typically, G values in the order of 1000 s^{-1} have been found acceptable for flash mixing. These values suggest that the flash mixing at the plant may be insufficient for optimum conditions. However, the operators have noticed no difference in the reactor clarifier performance in terms of sludge settleability or effluent turbidity when the in-line blender was in use.

C.3.f Flocculation and Sedimentation

The Deseronto WTP is equipped with an EIMCO reactor clarifier. Water enters the central conical flocculation chamber via a 254 mm diameter pipe and flows downward and out of the flocculation chamber into the outside clarifier ring. A schematic of the EIMCO reactor clarifier is presented in Figure C-4. Plates C-2 to C-4 show the reactor clarifier details. There are four sampling lines and taps in the clarifier. Three are at equally spaced depths in the clarification section while the forth is in the reaction zone.

Flocculation

Flocculation and recirculation is accomplished by a reactor-turbine driven by a 10:1 ratio variable speed drive with the following description:

Manufacturer:	Sterling Power Systems Inc.
Size:	0.75 kW
Rotational Speed (Drive):	460-1840 rpm
Rotational Speed (Turbine):	1.7-10 rpm

According to EIMCO, the manufacturer, turbidity removal is achieved through solids contact in the recirculating chamber and subsequent settling of aggregate floc. The goal of operating this unit is therefore to maintain the largest volume of recirculating sludge that is possible, without having such a high concentration of settled sludge that the sludge blanket can rise and potentially flow through the weir.

The 1.6 m diameter turbine with 12-26 cm blades operates at a rotational speed of approximately 4.2 rpm, or a tip velocity of 0.4 m/s. The turbine runs constantly in a clockwise direction, despite the "stop-start" operation of the plant, in order to maintain a concentration of sludge recirculating in the flocculation chamber.

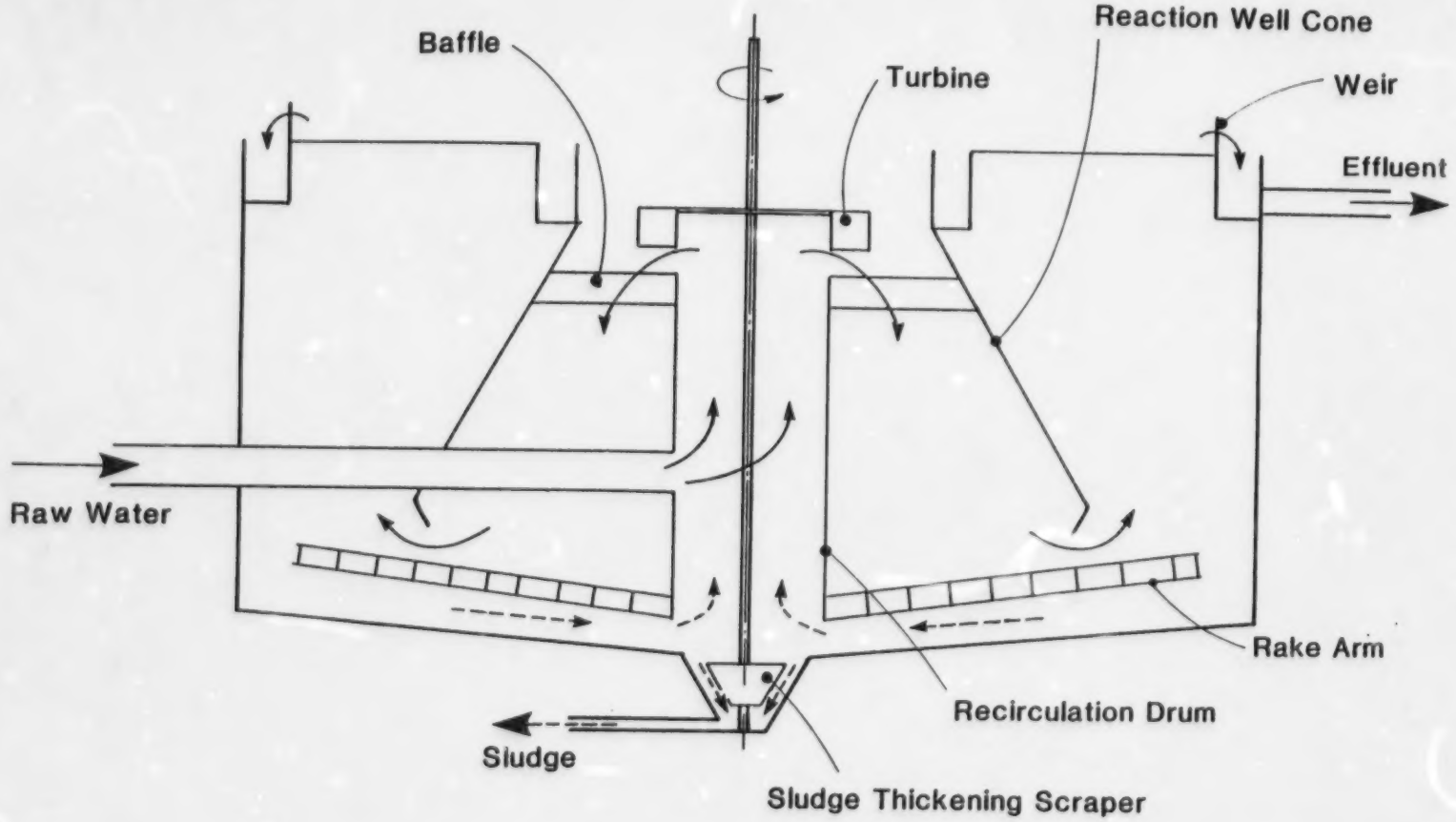


Figure C-4
SCHEMATIC OF REACTOR CLARIFIER
AT DESERONTO WATER TREATMENT PLANT

The settled sludge is drawn from near the tank bottom through a 1.1 m diameter steel recirculation drum. The influent water enters the recirculation drum 1.2 m from the tank bottom. The mixture of sludge and influent are discharged near the surface in the centre of the baffled steel conical reactor compartment. Flow is then downward with large volumes returning to the recirculation drum intake, and the remainder flowing outward under the cone into the clarification compartment.

The energy gradient (G) for paddle turbine drive flocculators can be calculated using the following equation:

$$G = \sqrt{\frac{C_D}{\nu}\frac{A_p^3 S}{V}} \qquad \text{(Eq. C-2)}$$

Where:
C_D = the coefficient of drag (=1.8)
n = the kinematic viscosity
A_p = the cross sectional area of the paddles normal to the direction of motion
s = the velocity of the paddles with respect to the liquid
V = the tank volume

Due to the nature of the design of the reactor at the Deseronto WTP, the G value for flocculation cannot be calculated from the available information. More specifically, neither the volume of the reaction cone that is affected by the turbine nor the relative velocity of the paddles can be accurately determined.

Clarification

The circular concrete clarifier is 9.8 m diameter and holds water at a depth of 3.5 m with 15.2 cm freeboard. The water flows upward through the tank and exits through the overflow weir: 100-32 mm diameter submerged orifices spaced equally around the inside perimeter of the clearwater collection channel. The 20.3 cm wide collection channel allows the clarified effluent to flow to the 254 mm diameter exit pipe.

The clarification process is described by the following parameters:

Surface area (excluding reaction chamber):	55.7 m^2
Overflow rate:	2.13 m/h
Hydraulic Retention Time (total):	128 min

According to the MOE Guidelines (Ref. 2), an overflow rate of 3.0 m/h is considered acceptable for reactor/clarifier units.

Sludge Collection

Rake arms rotate in a counter clockwise direction within the clarifier in order to draw settled sludge into the 1.5 m diameter sludge collection cone. A sludge thickening scraper within the cone rotates on the rake arm shaft. The rake arm and scraper system has the following description:

Drive Manufacturer:	Balder Electric Co.
Size:	0.19 kW
Rotational Speed (drive):	1725 rpm
Rotational Speed (rake arm and scraper):	12 rpm

The rotational speed of the rake arm and scraper results in a rake arm tip speed of 5.7 m/min. This value is somewhat higher than typical speeds, usually in the range of 0.3-4 m/min.

In order to waste sludge in a rate proportional to the volume of water treated, a timed solenoid valve opening allows sludge to exit the sludge thickening cone to the wastewater collection sump via a 10.2 cm diameter pipe. Plate C-5 shows the desludge timer and totalizer. The valve opening can be set at an interval from 0 to 2 minutes at a frequency of 0 to 2 hours. Each time the low lift pumps start up, the timer resets to 0 and sludge is wasted immediately and at each set interval after this as long as there is continual operation of the low lift pumps. The sludge flow rate is estimated at 45 L/s.

Despite the intermittent operation of the plant, the sludge rake and scraper operate constantly. MOE Guidelines (Ref. 2) recommend constant operation to prevent process upsets.

C.3.g Dual Media Filtration

Water from the reactor clarifier flows to a splitter box from which two 254 mm diameter pipes convey the flow to two identical sand/anthracite filters. The cylindrical filter units are also manufactured by EIMCO and are described in Table C-2. A schematic of a filter unit is shown in Figure C-5. Table C-3 lists the valve details. A wall mounted EIMCO analog controller is provided with the filter packages. Plate C-6 shows the filters and Plate C-7 shows the analog controller.

Filtration

Water enters the filter through a 254 mm diameter flanged pipe at the top of the filter compartment, and is distributed over the filter area of 7.3 m^2. FlexKleen nozzles with air extension tubes (for air scour) sitting in the floor of the filter compartment allow filtered water to flow to the collection chamber. From the collection chamber, water flows through the 254 mm diameter flanged transfer pipe to the storage compartment.

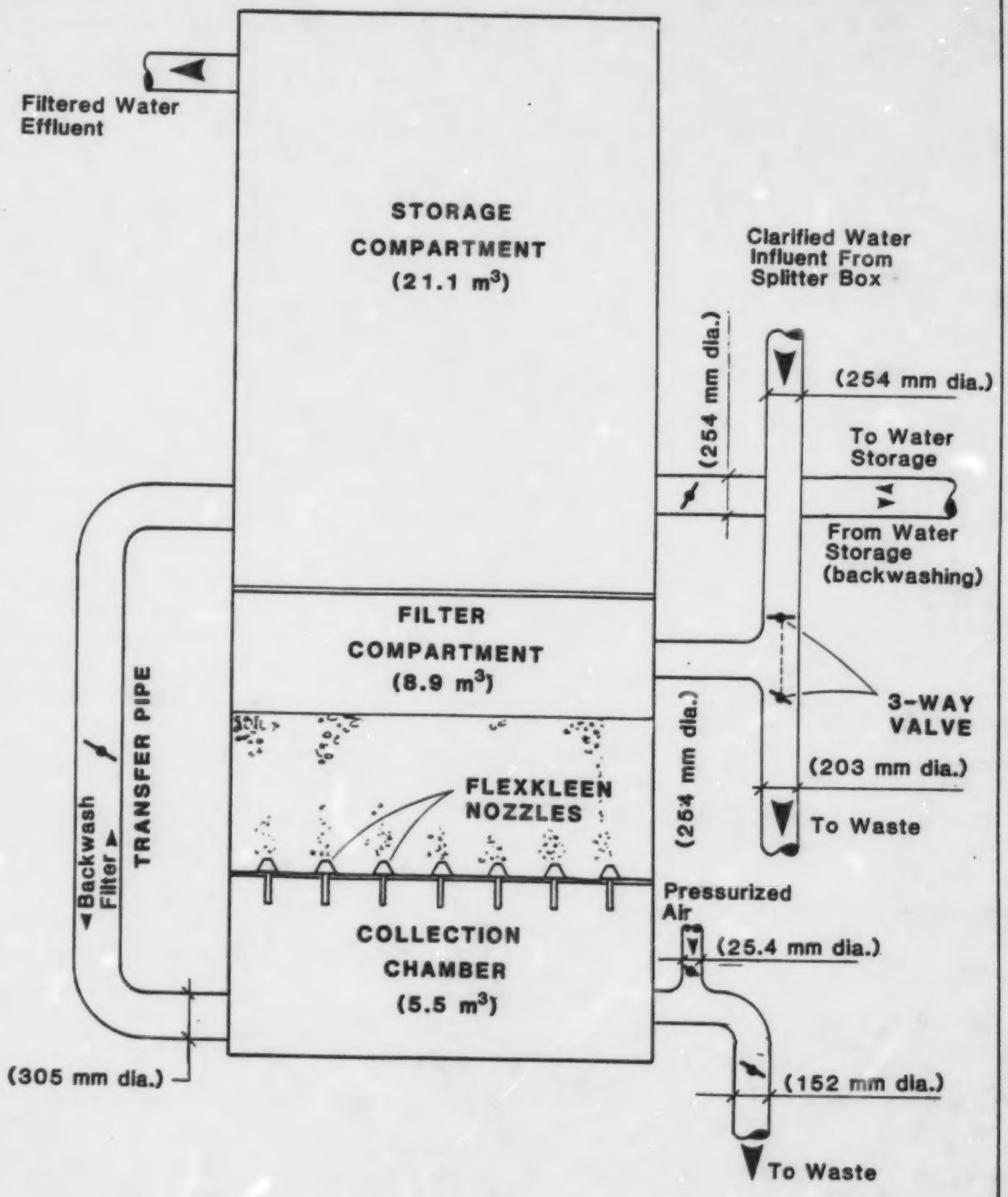


Figure C-5
SCHEMATIC OF SAND/ANTHRACITE FILTER UNIT AT DESERONTO WTP

Table C-2
DESCRIPTION OF SAND/ANTHRACITE FILTER UNITS AT DESERONTO WTP

Feature	Description	
Total Filter Unit	Height: Diameter: Material	4.88 m 3.05 m 6.4 mm steel
Water Storage Compartment	Height: Volume:	2.90 m 21.2 m^3
Filter Compartment	Height: Volume: Floor: Underdrain: Media:	1.22 m 8.9 m^3 6.4 mm steel FlexKleen nozzles with air extension tubes 0.30 m sand (2.2 m^3) 0.30 m anthracite (2.2 m^3)
Collection Compartment	Height: Volume:	0.76 m 5.6 m^3

Table C-3
SAND/ANTHRACITE FILTER VALVE DESCRIPTIONS

Description	Type and Size	Description
Clarified Water to Influent and Backwash Wastewater Influent Valve	254 mm x 203 mm 3-way butterfly valve	Pneumatic with solenoid pilot
Transfer pipe valve	305 mm butterfly valve	"
Drain	152 mm butterfly valve	"
Air Scour	25 mm butterfly valve	"
Filtered Water to Backwash Storage Tank Valve	305 mm butterfly valve	"

A backwash storage tank, made from 6.4 mm steel, is the same height as the filters (4.88 m) and sits at the same elevation as the filters. During filtration, a 254 mm diameter flanged pipe conveys filtered water to the storage unit to maintain equal water elevation in the filter storage compartment and the backwash storage tank. When the storage tank is filled, the filtered water overflows from the storage compartment into a 254 mm diameter filtered effluent pipe.

The backwash storage tank is 4.88 m high and 3.66 m diameter, with a total storage volume of 51.3 m^3.

Each filter is designed to hold a 0.30 m anthracite bed above a 0.30 m sand bed. The media in the filter was the original media placed at the time of construction in 1980. Sieve analysis data for the media are not presently available. In the summer of 1988, a problem with the FlexKleen nozzles in one filter caused loss of anthracite media. The media was therefore emptied and at this time new anthracite was added and the nozzles were repaired. The new anthracite was supplied by Anthracite Media and Coal Ltd., Hamilton, with an effective size of 0.9 mm and an uniformity coefficient of 1.5.

The depth of the media in both tanks was measured by CH2M HILL staff during the present study in August 1988, and it was found that media has not been lost in either filter. The media is visually inspected only about once every two years, and no core samples have ever been taken. Problems such as mudballs, cracking, etc. have never been noticed. The media is not inspected more frequently because the design of the filters makes this task awkward. The means normally used to detect filter problems (such as the recent nozzle clogging) is a marked increase in backwashing frequency.

The surface filtration rate at the flow capacity of 2.95 ML/day is 8.42 m/h if both filters are operating and 16.85 m/h for the short time that only one filter is operating (i.e. one is backwashing). At the rated capacity, the filtration rate is well below the maximum rate of 12 m/h recommended by MOE Guidelines (Ref. 2).

Backwashing

Backwashing occurs when the pressure head loss through the filter exceeds 1.52 m. The hydraulic backwashing procedure is automatic and only one filter may backwash at a time while the other filter continues to treat the flow.

Once the automatic pressure sensor has been activated, the backwash routine begins. Initially, the filter compartment is allowed to drain to the wastewater equalization tank through a 152 mm diameter drain pipe until the water level falls to the top of the filter media. An air scour through a 25.4 mm diameter pipe follows. The characteristics of the air scouring equipment shown in Plate C-8, are:

Manufacturer:	Roots Blower
Size:	5.6 kW

Other design information was not available at the time of this report.

If the water falls below the surface of the filter media during the drain down, as indicated by a level probe, air scour will not occur. The rapid drain down indicates that the filter media is not dirty enough to require an air scour.

Backwashing involves the down flow of water from the storage compartment/backwash storage tank through the transfer pipe and up through the filter. Backwash wastewater exits at the top of the filter compartment and goes through a 203 mm diameter pipe leading to the wastewater sump. After the backwash period, filtering resumes except that the drain remains open for a set interval so that the initial rinsewater is filtered to the wastewater sump. Normal operation then resumes. A detailed description of the backwashing procedure is described in Section D.4.e.

The analog controller of the backwash cycle has the following capacity:

Drain time:	0-10 minutes
Air Scour:	0-10 minutes
Backwash:	0-15 minutes
Rinse:	0-15 minutes

As mentioned in Section B., the plant staff assumes a volume of wastewater produced during backwashing of 21 m^3 for a 3 minute backwash period. In August 1988, CH2M HILL staff measured the volume of wastewater produced using 2 methods. The first method involved measuring the change in elevation of water level in the backwash storage tank, taking into account the flow contributed from the operating filter.

This volume was added to the volumes calculated for the drain down and rinse periods. The total volume of wastewater produced during a backwashing cycle was calculated to be 21 m^3. This volume compared favourably to the second method which used the volume of wastewater that entered the wastewater sump. This volume is remotely indicated by a continuously measuring level meter.

For a 3 minute backwashing portion of the cycle 15.6 m^3 of backwash storage water is consumed resulting in an average backwash surface loading rate of 32.3 m/h. Due to the design of the filters and the limited information it was not possible to observe or calculate a bed expansion. MOE Guidelines (Ref. 2) suggest a backwash rate of 45 m/h and a bed expansion of 30 percent.

C.3.h Granular Activated Carbon Contactors

Filtered water leaves the sand/anthracite filter storage compartment and flows into a splitter box. Each of two 254 mm diameter pipes convey half of the flow to each of two granular activated carbon (GAC) contactors supplied by EIMCO, for taste and odour control. Plate C-9 shows the splitter box and the GAC contactors.

Each contactor has the following characteristics:

Material:	6.4 mm steel
Dimensions:	3.05 m dia. x 2.43 m height
Media:	Filtrasorb 400, Calgon

Bed Depth:	1.52 m
Surface Area:	7.31 m^2
Effective Size:	0.55 - 0.75 mm

U.S. Std. Series Sieve
Size: > No. 12 - 5%
< No. 40 - 4%

FlexKleen Non Clogging plastic nozzles are located in the media chamber floor to transmit treated water into the collection chamber. A schematic of one contactor and valve descriptions are presented in Figure C-6. Each contactor is designed for a normal flow of 1.47 ML/day, or 2.95 ML/day during the short period that one is backwashing. These flow rates result in surface loading rates of 8.4 m/h and 16.8 m/h, respectively, which can be compared to typical GAC contactor surface loading rates in the range of 4.8 to 24 m/h. The empty bed contact time is 10.9 min for two filters operating and 5.4 min when one is operating. Treated effluent exits through a 254 mm diameter pipe.

Backwashing of the contactors is a manual operation that takes place at least once per week, but more often in summer months, when the plant is operating for more hours of the day. There are no process parameters used for indicating the necessity of backwashing. The backwashing procedure is initiated by closing the valves in the 254 mm diameter filtered water influent pipe and the 254 mm GAC treated water pipe. The valves for the 305 mm diameter wastewater pipe and the 305 mm diameter backwash water pipes are then opened and backwashing takes place. A Tygon tubing line on each backwash pipe allows viewing of the backwash wastewater. After the backwashing period all the valves are closed and the 152 mm diameter drain may be opened to allow any remaining backwash water to drain to the wastewater sump. Normal operation resumes when the valves in the GAC treated water pipe and the filtered water influent pipe are reopened.

Based on the system hydraulics, the backwash rate is 4.45 m^3/min, resulting in the volume of water to be used during a 5 minute backwash cycle of 22.3 m^3 and a backwash loading rate of 36.5 m^3/m^2h. A volume in the range of 15.8 m^3 to 31.6 m^3 is used by the plant to calculate wastewater flow rates, based on the change in water elevation in the wastewater sump. At present, the valve in the backwash water pipe is throttled to about 60 percent. The backwash flow rate can be increased or decreased by adjusting this valve.

Calgon, the media manufacturer recommends an optimum bed expansion of 50 percent or 1.83 m. According to Calgon, the ideal backwash loading rate varies linearly with temperature, from 18.2 m^3/m^2h for 2°C to 31.7 m^3/m^2h for 25°C, for Calgon Filtrasorb 400 media.

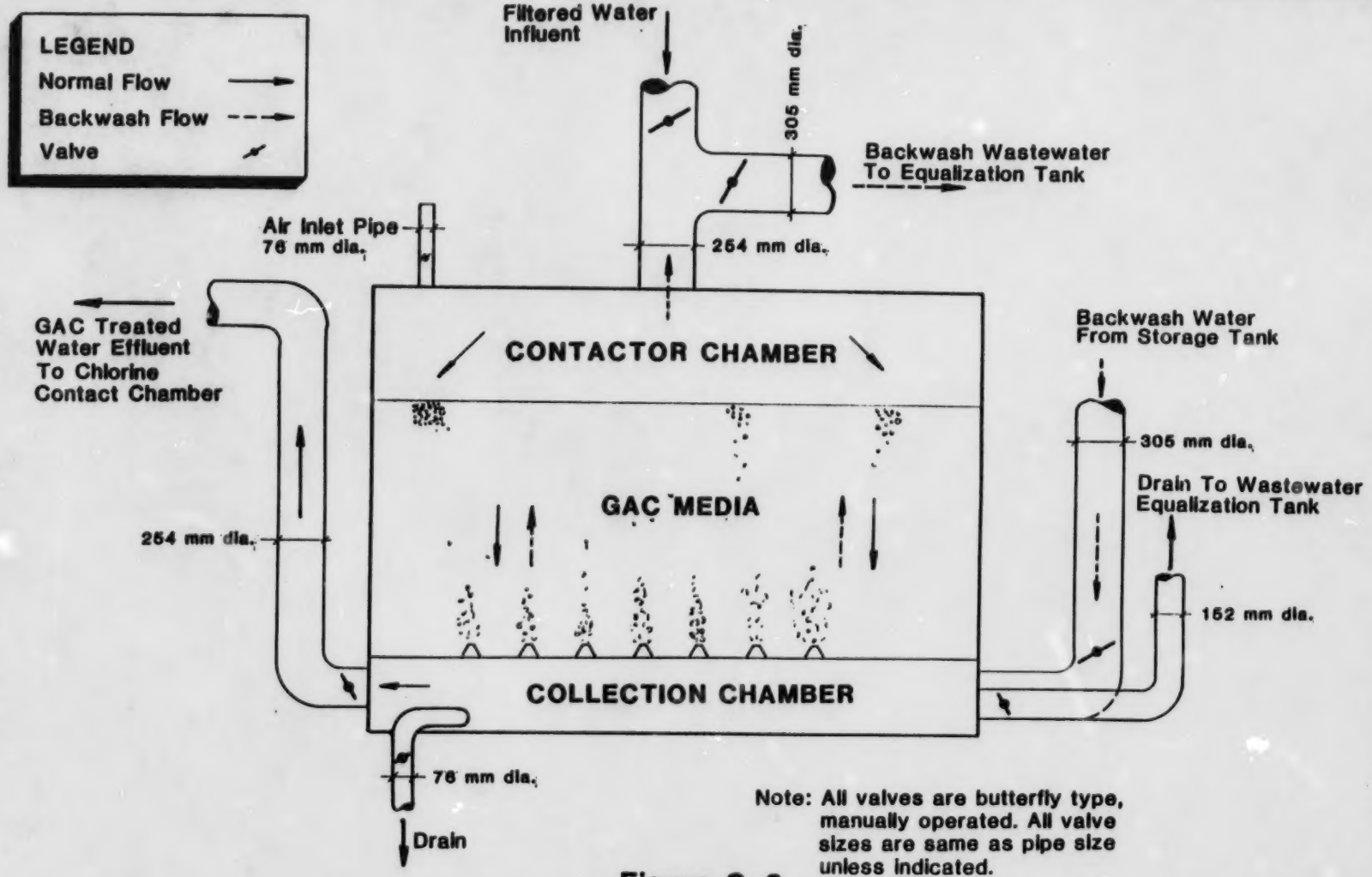


Figure C-6

SCHEMATIC OF GAC CONTACTOR CONFIGURATION AT DESERONTO WTP

C.3.i Post-Chlorine Contact Chamber

Treated water receives pH adjustment just after (about 1 m) a post-chlorine addition point, and then passes through an in-line static mixer and enters the post-chlorine contact chamber. The concrete chamber is an L-shaped channel, 1.2 m wide with 5.5 m SWD. A 21.0 m long section has 0.6 m long baffles spaced at 2.1 m on alternating sidewalls. An additional section is 3.3 m long and has no baffles. The total volume of the chamber is 160.4 m^3 and the detention time, based on present operating conditions, is 1.4 hour. Detention times for various operating conditions are:

1 high-lift pump operating: 83 minutes
2 high-lift pumps operating: 42 minutes
3 high-lift pumps operating: 21 minutes
4 high-lift pumps operating: 10 minutes

A 305 mm pipe exists to allow bypassing of the chlorine contact chamber to one or the other of the clearwells.

C.3.j Clearwells

Water from the chlorine contact chamber can enter one of two concrete clearwells for storage. The clearwell storage dimensions are:

Clearwell #1: 21.0 m x 3.3 m x 5.5 m SWD, 371.1 m^3 volume
Clearwell #2: 19.4 m x 3.3 m x 5.5 m SWD, 342.8 m^3 volume

Total 713.9 m^3

Each clearwell contains inlets for 2 of the 4 high lift pumps. Water leaving the post chlorine contact chamber can enter either one or the other or both of the clearwells, depending on the position of the 406 mm butterfly valves at the entrance to each clearwells. The resulting detention times are presented in Table C-4.

Table C-4
SUMMARY OF CLEARWELL HYDRAULIC DETENTION TIMES

Clearwell Valve Configuration	1 Pump Operating	2 Pumps Operating	3 Pumps Operating	4 Pumps Operating
Clearwell #1 opened, Clearwell #2 closed	3.2 h	1.6 h	-	-
Clearwell #1 closed, Clearwell #2 opened	3.0 h	1.5 h	-	-
Both Clearwells opened	6.2 h	3.1 h	2.1 h	1.5 h

At present, the plant is operated so the water can enter either clearwell (i.e. both valves are opened) resulting in a hydraulic retention time of 6.2 hours at the plant operating capacity.

C.3.k High Lift Pumping

There are four high lift pumps available for pumping final treated water to the distribution system and the storage standpipe. Two pump intakes are located in each clearwell. Plate C-10 shows the high lift pumps. Each pump has the following characteristics:

Type:	Horizontal, double suction, centrifugal
Manufacturer:	Crane Canada Ltd.
Capacity:	2.78 ML/d
THD:	61 m
Motor:	Reliance, electric
Size:	37 kW
Rotational Speed:	1750 r/min

Each pump discharges into a 102 mm diameter pipe connected to the main 254 mm diameter pipe leading to the Town distribution system. Presently, only one pump is utilized for high lift pumping.

C.3.l Wastewater Disposal

Sludge from the clarifier, and backwash and rinsewater from the sand/anthracite filters and the carbon contactors enters a wastewater sump, 15.9 m by 4.9 m and 2.0 m deep with a total volume of 158 m^3. A wastewater pump sends water to the Deseronto WPCP on the adjacent site for treatment. The pump begins operation when the wastewater level in the sump reaches a high level sensor, and shuts off when the water level drops to a low level sensor. Plate C-11 shows the wastewater pump. The pump characteristics are:

Manufacturer:	Crane Canada Ltd.
Capacity:	1.05 ML/d
THD:	9.14 m
Size:	1.5 kW
Motor:	Electric Motors of Canada Ltd.

In the past, emergency situations have caused the wastewater sump capacity to be exceeded. This has occurred when filter clogging has caused continuous backwashing. These situations have not occurred for a few years. When the capacity is exceeded, a high water level alarm is activated, and the wastewater overflows into a pipe which can direct the flow into a storm sewer which discharges into the Bay of Quinte. Wastewater can only flow into the storm sewer if the valves are opened manually.

The plant Supervisor has made a request for a standby wastewater pump, for emergency situations, as well as maintenance and repair.

C.4 CHEMICAL FEED SYSTEMS

C.4.a Coagulant

Supplier

The liquid alum ($Al_2(SO_4)_3 \cdot 18H_2O$) is used as the primary coagulant at the Deseronto Water Treatment Plant, is supplied by Alcan Aluminum Ltd. of Montreal, Quebec.

Storage

There are 2 main horizontal filament bound pipe (FBP) tanks used for liquid alum storage. Each tank is 1.1 m diameter and 12.8 m long, resulting in a total storage volume of 22.9 m^3. The storage tanks are located on the upper level of the plant. Plate C-12 shows the alum storage tanks.

Liquid alum flows by gravity from the main tanks into a 2.1 m^3 polyethylene drum which serves as an intermediate tank located on the main floor of the plant. The drum is equipped with a LIGHTNIN Mixer driven by a 0.56 kW Reliance Motor. Plate C-13 shows the intermediate tank.

Feedlines

Liquid alum flows from the main storage tanks to the intermediate tank via a 28 m OF 25 mm diameter PVC pipe. From the intermediate tank, alum is pumped to the application point, located 2.5 m before the in-line blender, via 10 m of 25 mm diameter PVC pipe. A flushing system using plant service water is available for cleaning feed lines as required.

Pumping

Two chemical feed pumps are available at the plant for feeding alum. Plate C-14 shows the alum feed pumps. Only one pump operates at present, while the other is available for standby. The pumps have the following characteristics:

Manufacturer:	B.I.F.
Type:	3 Stage Pully System
Stage 1 Capacity:	13-83 mL/min
Stage 2 Capacity:	22-146 mL/min
Stage 3 Capacity:	30-242 mL/min

The start of alum pump operation is automatic with the start of the operation of the low lift pump. The alum pump will shut off simultaneously with low lift pumps.

C.4.b Coagulant Aid

Supplier

A commercial polyacrylamide anionic based polyelectrolyte (Aquafloc 6465) is used as the coagulant aid. The Aquafloc, supplied by Dearborne Chemical Co. in Mississauga, is delivered to the plant in powdered form.

Storage

A 2.1 m^3 polyethylene tank serves as the Aquafloc mixing and storage tank. Approximately every 2 weeks, as needed, powdered polyelectrolyte is mixed with treated water to form a polymer solution for pumping. Plate C-14 shows the Aquafloc tank.

The tank is equipped with a LIGHTNIN Mixer driven by a 0.56 kW Reliance Motor for mixing up the Aquafloc solution. During the period of mixing polymer solution, the low lift pumps are not in operation.

Feedlines

The Aquafloc solution is pumped from the polyethylene drum into the in-line blender about 2 m after the alum addition point. The feed line is 7.5 m of 25 mm diameter PVC pipe. A flushing system using treated water is available for cleaning the feed line.

Pumping

There are two feed pumps for coagulant aid, each with the following characteristics:

Manufacturer:	B.I.F.
Type:	3 Stage Pully System
Stage 1 Capacity:	13-83 mL/min
Stage 2 Capacity:	22-146 mL/min
Stage 3 Capacity:	30-242 mL/min

Plate C-14 shows the Aquafloc feed pumps. Only one pump operates at present while the other is available for standby. As with alum, the operating pump operates only when low lift pumps are operating.

C.4.c Disinfection

Supplier

Chlorine in 68 kg pressurized gas cylinders is supplied by Stan-Chem (Division of CIL), Toronto, Ontario. There are 14 empty or full cylinders at any time at the plant kept in the air-tight chlorine room, on the main floor of the plant.

Equipment

There are 3 chlorinator and injector systems located in the chlorine room, each with the following characteristics:

Manufacturer:	ADVANCE
Capacity:	11.4 kg/d
Water Flow Meter:	Rotometer

Water to the chlorinators is supplied by the plant service. One chlorinator system is presently used at the plant for post chlorination. The second system is available for pre-chlorination and the third is available for standby.

Feedlines

All of the chlorine feedlines are 25 mm diameter PVC. A 6 m pre-chlorination feed line, can apply chlorine solution to a point just after the raw water sampling point, upstream of the pre-chlorination chamber.

The post-chlorination application point is located just before the static mixer, utilizing in 17 m of feed line. If the carbon contactors are bypassed, the chlorine follows another route and is applied to a point in the bypass pipe, thereby using 23 m of feed line.

C.4.d pH Adjustment

Supplier

High grade powdered lime is supplied in 23 kg bags by Methot Sales Ltd. in Ottawa, Ontario. Soda ash in 23 kg bags is supplied by Lawrasons Chemical Ltd. in Rexdale, Ontario. The suppliers of both lime and soda ash are changed frequently, depending on the purchase price of the products.

Bags of lime and soda ash are fed alternately to the pH adjustment system. Soda ash is the preferred additive because it is less messy and the equipment handles it well. However, the existing supply of lime at the plant must be used up.

Feedlines

Soda ash or lime solution flows through about 13 m of 19 mm dia polyethylene to a point in the in-line static mixer, about 1 m after post-chlorination application. The lime/soda ash feed pumps operate continuously, independent of low lift pump operation.

Equipment

A lime/soda ash feed system at the plant consists of a bagloader, hopper, feeder, dissolver and 3 feed pumps, located on the lowest level of the plant. Plate C-15 shows the lime feed system.

The bagloader is suitable to handle 23 kg of hydrated lime or soda ash. A 20.3 cm diameter chute allows the lime/soda ash to flow to the hopper below.

The hopper has a volume of 1.2 m^3 and is made up of a 0.9 m diameter cylindrical section and a conical bottom section, with a manual bin gate.

The volumetric feeder by B.I.F., has a dry feed capacity of 0.06 m^3/h. The feed rate is manually adjustable over a 20:1 range. The unit has a progressive helix feeder, with a pulsating diaphragm, built in to prevent bridging of the lime. However, it has been found to compact lime into the hopper causing the lime flow to be obstructed when bridging does occur. The feeder discharges directly into the dissolver tank.

The polyethylene dissolver tank has a capacity of 191 L, and is equipped with a LIGHTNIN Mixer driven by a 0.19 kW electric motor. The flow of water from the plant supply into the tank is controlled by a rotameter flow meter, with 0.41 m^3/hour capacity. The flow and feeder are set to automatically produce a 10 percent solution. The accuracy of these settings have never been tested, because pH control is based on treated water pH and not a calibrated feed dosage.

Level probes in the tank control the water flow and lime feed.

There are three B.I.F. lime feed pumps, each with a capacity of 45.4 L/h. Only 2 pumps are in operation. The third is available for standby.

C.5 SAMPLING

Sampling lines for raw water and treated water were recently (1987) installed for DWSP sampling. Both lines are 25 mm diameter stainless steel, with stainless steel valves. Table C-5 presents details of the DWSP sampling lines.

All samples other than those for DWSP are collected from sample lines leading to laboratory room taps. Plate C-16 shows the DWSP raw water sampling tap. Plate C-17 shows the DWSP and in-plant treated water sampling taps.

Table C-5
DESERONTO WATER TREATMENT PLANT SAMPLE LINE DETAILS

Sample Type	Sample Intake Location	Sample Tap Location	Sample Line		Water Pressure
			Material	Length/Dia.	
DWSP Raw Water	Raw water main	Lower level of plant	Stainless steel	14m/25mm	Gravity flow
DWSP Treated Water	Treated water clearwell	Laboratory	Stainless steel	6m/24mm	RVPP pump 0.25 kW stainless steel impeller
In-plant Raw Water		Laboratory	Plastic	14m/32mm	Gravity flow
In-plant Treated Water		Laboratory	Copper	6m/32mm	Pumped

C.6 STANDBY POWER

A standby generator located in the WTP serves the Deseronto WTP. When there is a power failure, the generator automatically starts operating to allow normal operation at both plants to continue. An automatic exerciser on the diesel generator runs the unit for approximately one hour each week. Plate C-18 shows the standby generator.

The diesel engine has the following characteristics:

Manufacturer:	Cummins, U.S.A.
Model:	KT 1150 G
Speed:	1800 rpm
Engine Size:	7419 cm^3, 6 cylinder
Continuous Rating:	4071 kW

The generator has the following characteristics:

Manufacturer:	Stamford, England
Continuous Rating:	250 kW
Output:	600 V, 3 phases, 60 Hz

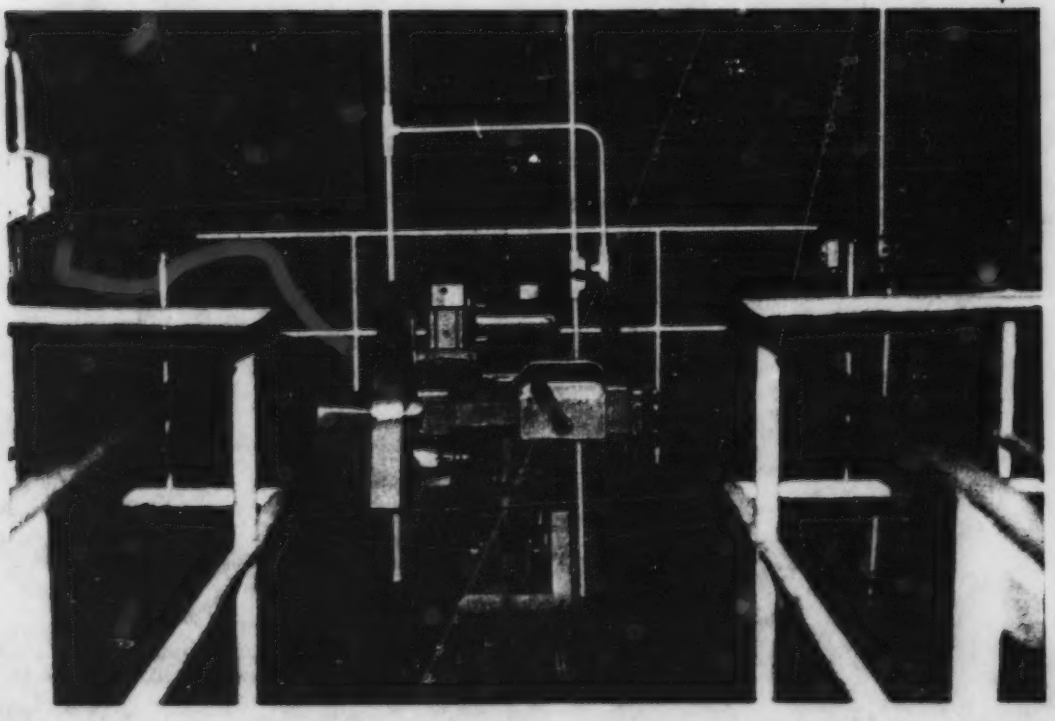
C.7 PLATES

▲ C-1, IN-LINE BLENDER

C-2, REACTOR CLARIFIER ▼

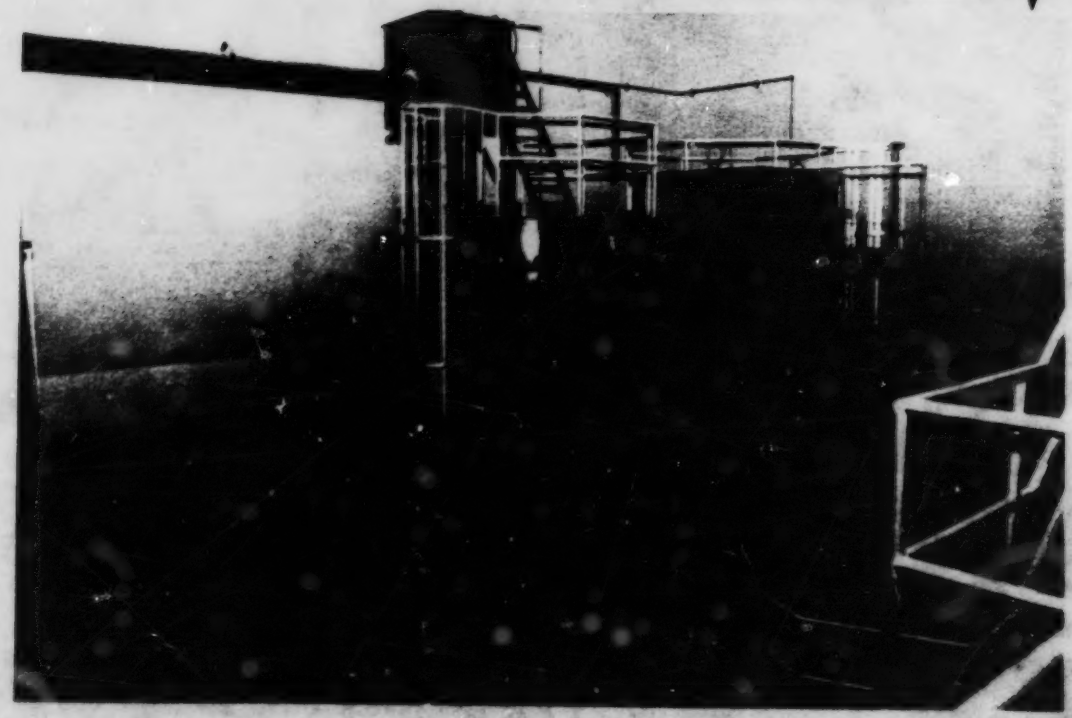
▲ C-3, OVERFLOW WEIR FOR CLARIFIED WATER

C-4, VARIABLE SPEED TURBINE DRIVE FOR FLOCCULATION AND SINGLE SPEED DRIVE FOR SLUDGE COLLECTION ▼



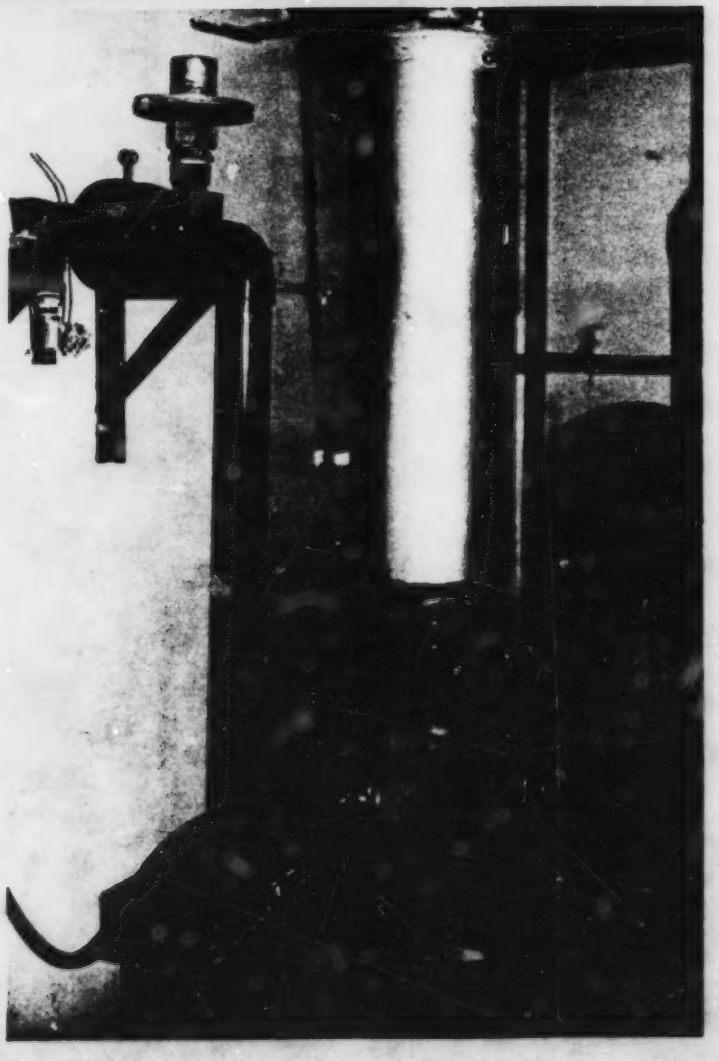
▲ C-5, DESLUDGE TIMER AND TOTALIZER

C-6, SAND/ANTHRACITE FILTERS ▼



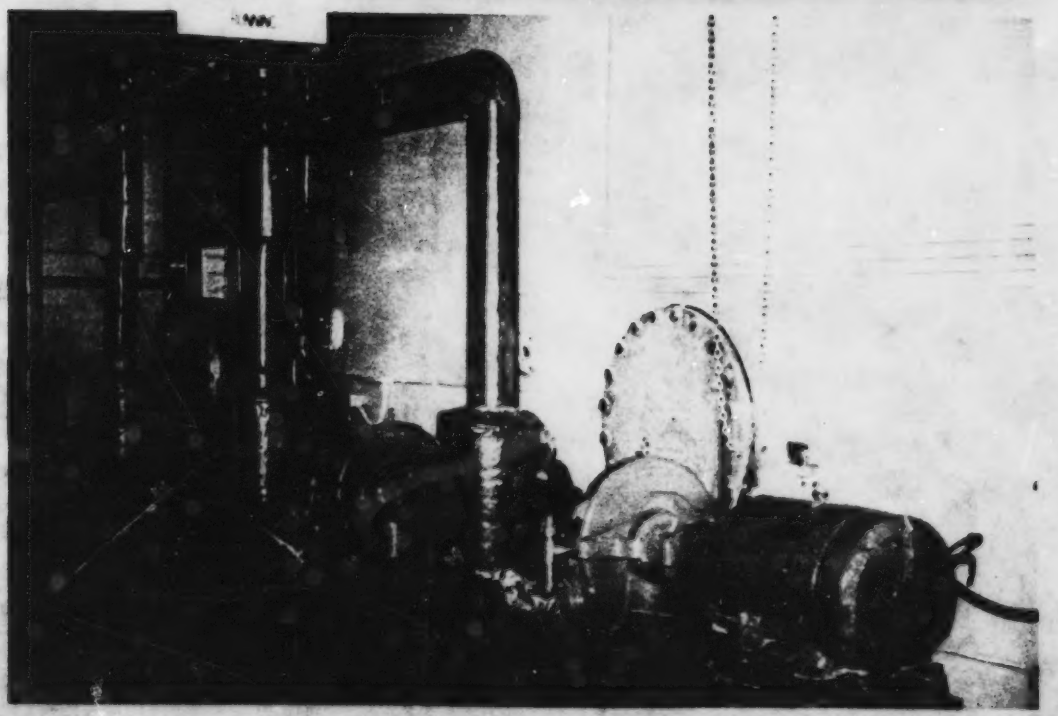
▲ C-7,
SAND/ANTHRACITE
FILTERS ANALOG
CONTROLLER

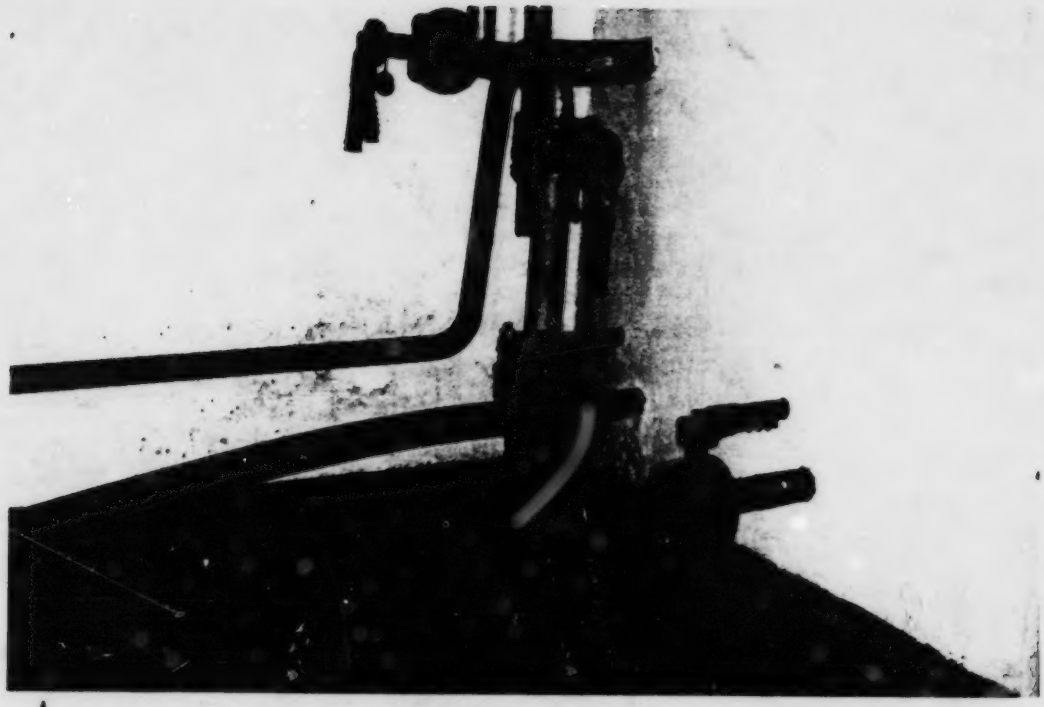
► C-8,
AIR BLOWER FOR
FILTER AIR SCOUR



► C-9,
GAC CONTACTORS

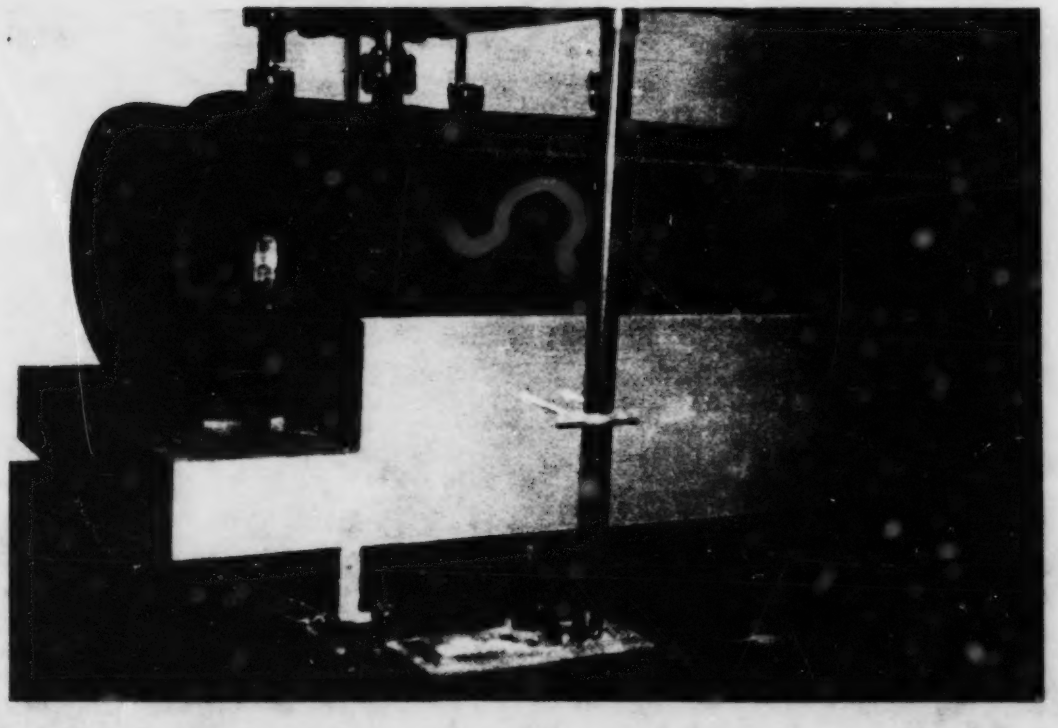
▼ C-10,
HIGH LIFT PUMPS

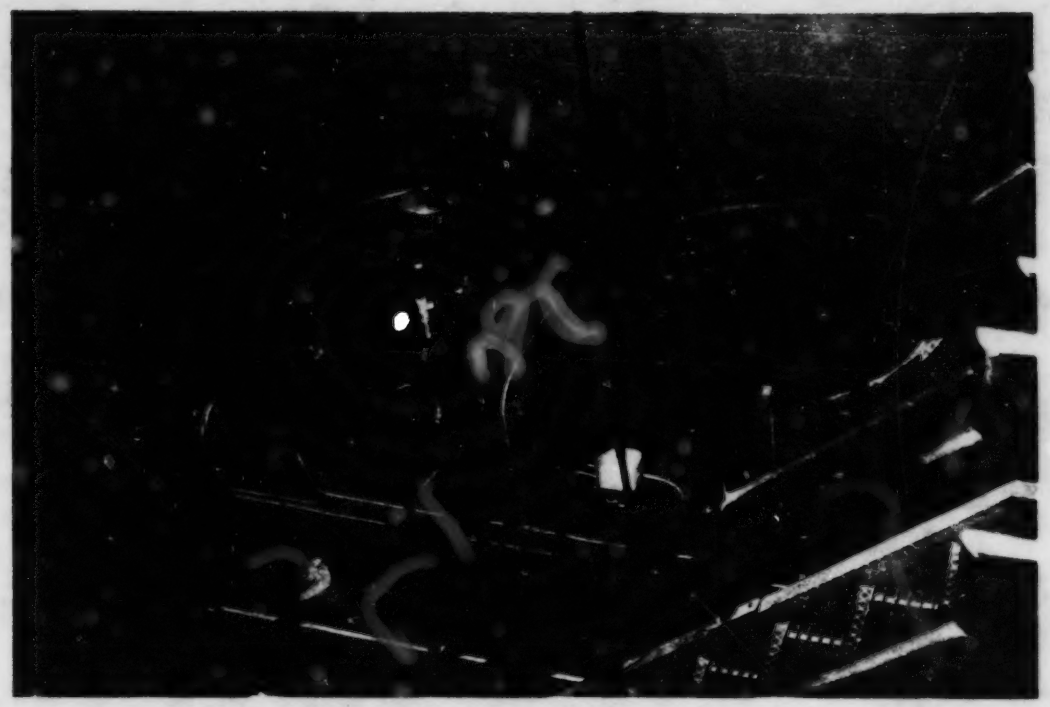




▲ C-11, WASTEWATER PUMP

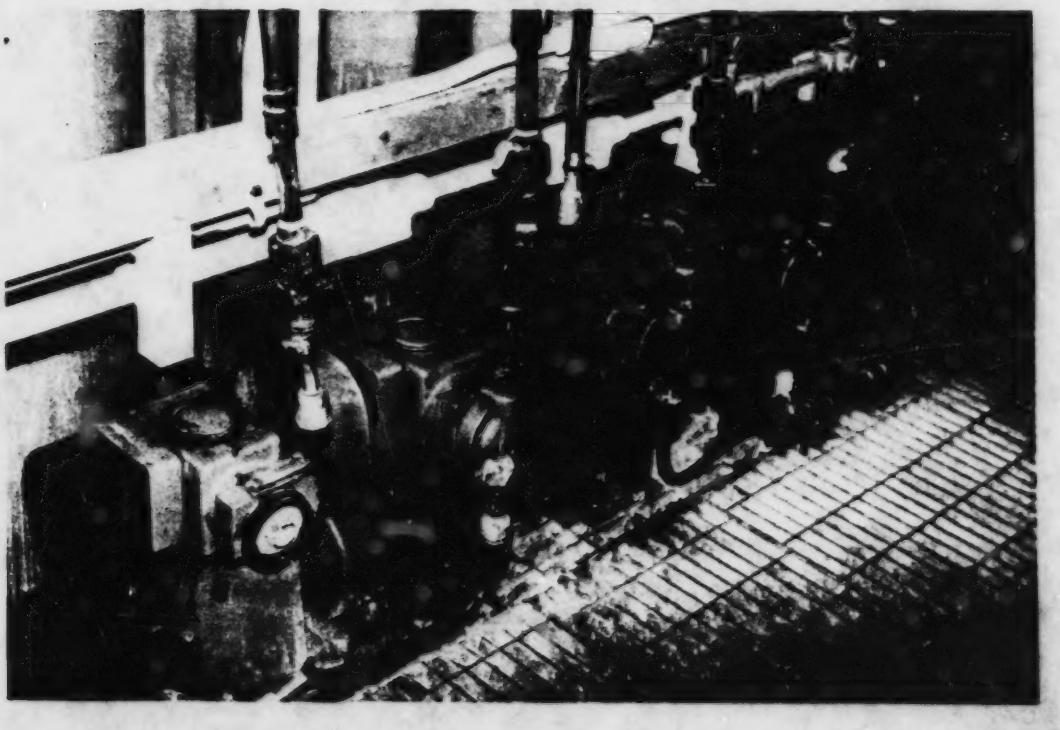
C-12, ALUM STORAGE TANKS ▼

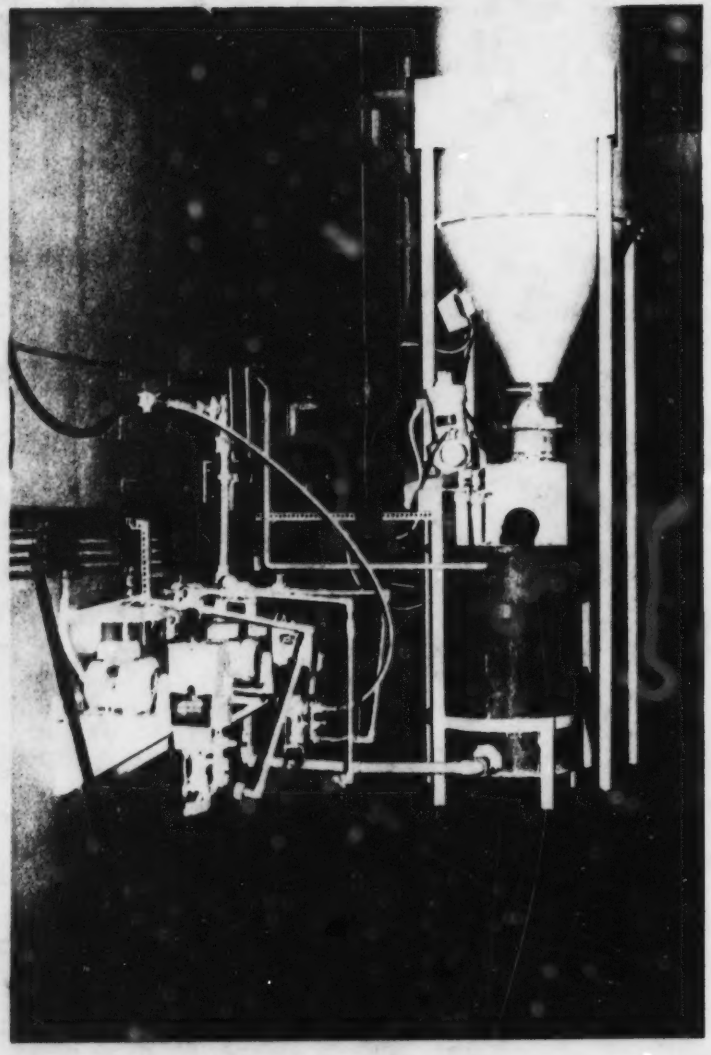




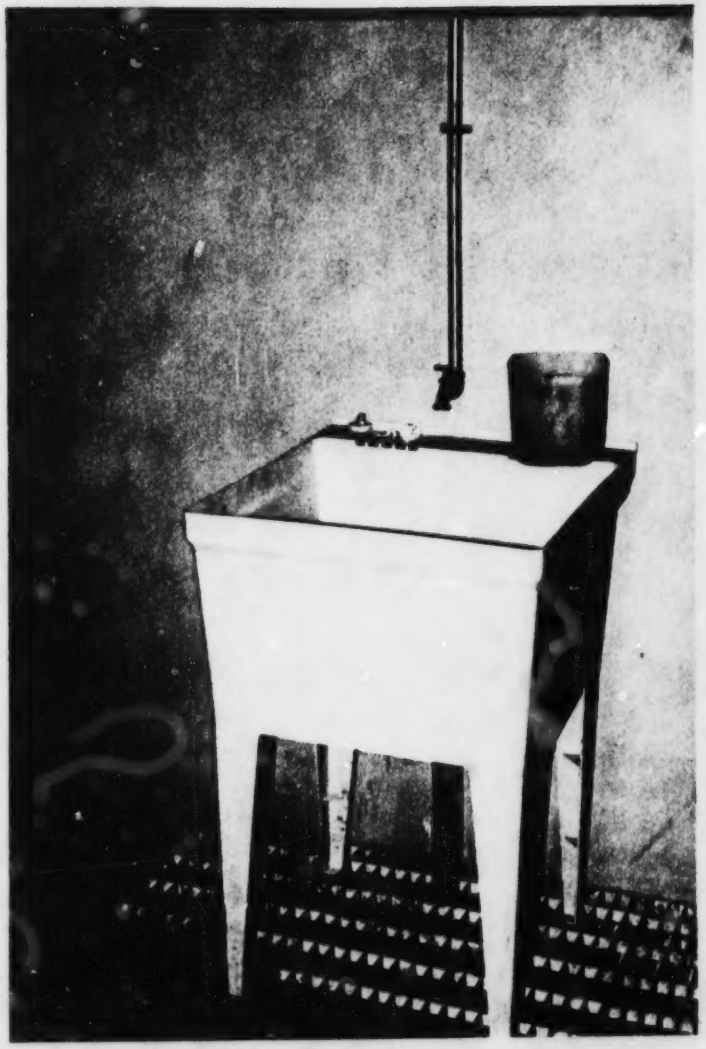
▲ C-13, ALUM & POLYMER DAY TANKS

C-14, ALUM & POLYMER FEED PUMPS ▼

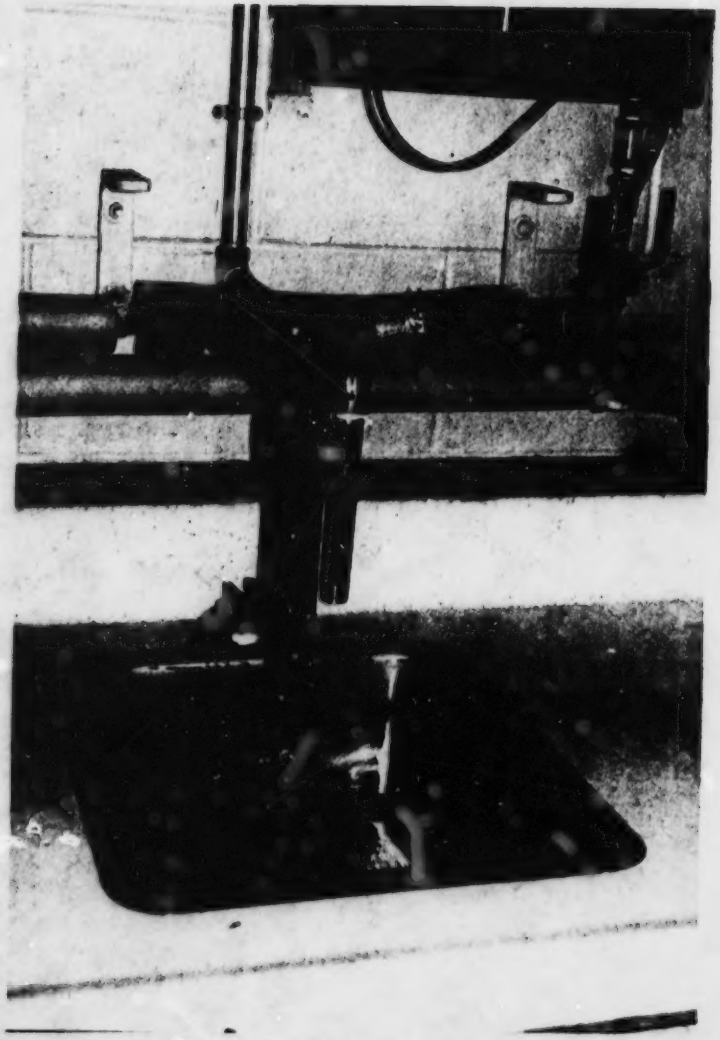




C-15, LIME FEED SYSTEM



C-16, DWSP RAW WATER SAMPLING TAP



C-17, DWSP AND IN-PLANT TREATED WATER SAMPLING TAPS

C-18, STANDBY GENERATOR

D. PLANT OPERATION

D.1 GENERAL DESCRIPTION

The Deseronto Water Treatment Plant built in 1979/80, was designed by L.S. Love and Associates Ltd., Brampton, Ontario. It presently serves a population of about 2000 in the Town of Deseronto and nearby Tyendinaga Indian Reserve. Raw water taken from the Bay of Quinte undergoes coagulation, flocculation, clarification, granular media filtration, granular activated carbon (GAC) adsorption, pH adjustment and chlorination before entering the distribution system. The primary coagulant is liquid alum, and a commercial polyelectrolyte is used as a coagulant aid. Lime or soda ash is used for pH adjustment.

The plant is designed to treat water at the rate of 2.95 ML/day. In 1987, the maximum daily raw water flow volume was 3.0 ML/day or 100 percent of the plant capacity, and the average daily flow volume was 1.46 ML/day or 50 percent of plant capacity.

D.1.b Operation

The water treatment plant operates automatically in a 'start-stop' mode. Clearwell level controls low level pumping. High lift pumps are controlled by a pressure transducer-transmitter located on the town distribution system standpipe.

Alarms are located at a number of locations around the plant to signal variations in normal treatment process and plant operations as well as potential emergencies. Alarm locations are shown in Figure D-1. Although the online residual chlorine analyzer is equipped with an alarm facility, it is not connected at present. The only process performance alarm is associated with an online continual treated water turbidimeter. However, the Supervisor is unsure of the high level setting and because it has never been activated, feels it may not actually be connected to an alarm. The plant Supervisor intends to have it inspected during the routine annual meter calibration. The results from this meter are not used for plant operational control. In all except one case, activation of an alarm will cause the low lift pumps to lock out of operation until manually switched back to automatic. The only exception is the occurrence of a power failure, in which case the standby generator will restart automatic plant operation.

The in-place contingency alarms, described above, are to allow immediate action on WTP process problems during manned or unmanned periods. Each of the alarm locations is represented by a labelled light on the control room panel. When an alarm is activated, a bell sounds and the panel light comes on. In addition, a local paging service will notify the designated person "on-call".

Splitter Box #1 High Level	Splitter Box #2 High Level	Waste Sump High Level	Plant Sump High Level	Pumphouse Sump High Level	Effluent Flouride High	Effluent Flouride Low
Standpipe High Level	Standpipe Low Level	Lime Tank High Level	Lime Tank Low Level	Clearwells High	Clearwells Low	Backwash Water Storage Tank High Level
Low Lift Pump #1 No Discharge	Low Lift Pump #2 No Discharge	Low Lift Pump #3 No Discharge	High Lift Pump #1 No Discharge	High Lift Pump #2 No Discharge	High Lift Pump #3 No Discharge	High Lift Pump #4 No Discharge
Alum Feed Tank High Level	Polyelectrolyte Feed Tank	Lime Hopper Low Level (not in use)	Alum Storage Tank Low Level (not in use)	Alum Storage Tank High Level	M.C.C. Ground Fault	Diesel Generator No Output (not in use)
Prechlorinator High Vacuum	Prechlorinator Low Vacuum	Post Chlorinator High Vacuum	Post Chlorinator Low Vacuum	Chlorine Leak	Compressed Air Low Pressure	High/Low Chlorine Residual (not in use)
Clarifier pH High (not in use)	Clarifier pH Low (not in use)	Clarifier Rake High Torque	Effluent Turbidity High	Effluent pH Low (not in use)	Effluent pH High (not in use)	Sludge Blowdown Valve

Figure D-1
SCHEMATIC OF ALARM PANEL AT DESERONTO WTP

The Deseronto WTP is operated by the MOE. At present, the WTP is not yet classified in the MOE Classification Program and Operator Certification Program. There are 2 full time MOE employees at the water treatment plant, who are also responsible for the Deseronto WPCP on the adjacent site. In addition to the Supervisor and an Operator, a summer student, a contract person or a government work experience program person is hired. The 3 staff members work 8 hours per day, 5 days per week. During nights and weekends, the plant is not manned. However, the Operator and Supervisor alternate weekly the responsibility of being on call during non-working hours.

Regular plant operation includes administration, quality control, maintenance and inspection. All of these duties are the responsibility of the Supervisor and Operator.

D.2 FLOW CONTROL

Flow control at the Deseronto Water Treatment Plant is entirely automated. The plant is provided with three single speed low lift pumps. Two low lift pumps operate at a time, resulting in a constant pumping rate during operation of 2.95 ML/day.

As previously described, the low lift pumps operate intermittently, depending on the level of water in the clearwell storage. The level in the clearwells is continuously monitored and remotely indicated with level switches for control of raw water pumps. The low water level sensor in the clearwells is located at 90 percent of clearwell capacity. The high water level is located at 98 percent. Therefore, the actual "active" volume is 80 m^3. If necessary, the automatic low lift pump control can be switched to manual. This occurs only when plant operation must stop for maintenance or repair.

The high lift pump operation is automatic. There are 4 available pumps, each with a capacity of 2.78 ML/day. However, at present only one pump operates at a time. The level in the Town standpipe is continuously monitored and remotely indicated with pressure transducers for control of the high lift pumps. During the nighttime, when there is little water demand, the plant staff report that it takes about 45 minutes to fill the tower. This indicates that there is an available operating volume of about 80 m^3.

D.3 OPERATION OF SPECIFIC COMPONENTS

D.3.a Intake and Screening

Bay of Quinte water is conveyed by gravity to the low lift pump house via 488 m of polyethylene pipe. The intake well can be closed during inspection and cleaning by means of a 406 mm gate valve.

There is no backflushing system in place at the pump house for the intake line. When backflushing is required, a fire truck is used to force water through the line. Backflushing was required only once in the plant's history, as a result of frazil ice clogging.

Once each year divers are hired to inspect the raw water intake for clogging or structural problems. No problems have ever been observed. At this time, the wet well screens are removed and hosed down using fire hydrant water to remove any biological growth. Because of the depth of the wet wells and the difficulty of the task, the wet well has never been emptied or cleaned. However, this job is to be undertaken in 1989.

D.3.b Low Lift Pumps

Three low lift pumps located in the low lift pump house are available for withdrawing water from the intake well. They discharge into 102 mm diameter discharge pipes which are connected to a 254 mm diameter pipe that conveys water to the plant. Pump descriptions are presented in Section C.2.3.

As previously described, two of the three low lift pumps automatically begin operation as a result of a feedback signal from the water level transmitter in the treated water clearwells, at a low water level. When the water reaches a high level in the clearwells, a signal is transmitted for the low lift pumps to stop operation.

The main operating pumps are rotated every 3-4 weeks.

D.3.c Flash Mixing

An in-line flash mixing unit is available at the Deseronto WTP for rapid mixing of coagulant and coagulant aid in raw water. This system is not in use at the plant. Instead 18 m of 254 mm dia, raw water pipe are employed for rapid mixing. The pipe, including 5 elbows, has a nominal retention time of 27 seconds. In spite of low G values calculated for this type of mixing system, the plant staff observed no differences in clarifier performance between the present method and the use of the in-line blender. This observation was based on a non-rigorous comparison of treated water turbidities, for both situations. As discussed in Section E, a more rigorous analysis of the effect of the in-line mixer is recommended to confirm these observations.

D.3.d Flocculation/Clarification

Flocculation and clarification take place in the reactor clarifier described in Section C.3.g. Slow mixing for flocculation is accomplished by a variable speed turbine. At present, the turbine is rotating at 4.2 rpm, or about 50 percent of the drive capacity. The turbine speed has not been changed since 1983. The present setting was found by trial and error in 1983.

The sludge blanket level in the clarifier is dependent on the sludge wasting interval and frequency. This frequency is based on the volume of water treated. However, sludge wasting also occurs each time the plant operation starts. In order to control the sludge level, a slurry sample taken daily from the recirculation chamber undergoes a 5 minute

settling test in a 1000 mL graduate cylinder. Plant staff have found that the ideal settled sludge volume is in the range of 20 to 40 percent (200-400 mL). This solids concentration will allow sufficient solids for contact in the clarifier and not create high sludge blanket that could potentially carry over the weir. If the sludge volume is greater than 50 to 60 percent, the frequency and interval are adjusted. The adjustments are based on past trial and error results. Plant staff have compiled data to aid in setting the desludge timer at different flow rates.

During the low water demand months, the plant often operates for very short periods (less than 1 hour). This results in more frequent sludge wasting intervals since sludge is released each time the plant starts up. The plant staff find it difficult to maintain an ideal frequency and period length for sludge wasting during these months, because the period between wasting varies depending on the length and frequency of a period of low lift pump operation.

As recommended in MOE Guidelines (Ref. 2), the sludge recirculation turbine and rake arm collection system operate continuously despite the start-stop mode of the plant operation.

Water quality turbidity measured in raw and treated water is used for control of the overall plant operation. However, there are no parameters measured to evaluate and control the performance specifically of the reactor clarifier.

D.3.e Filtering

The two sand/anthracite media filters operate in 2 modes; filtering and backwashing. Maintenance and repair of filter equipment is performed as required. The filter media is minimally inspected annually and has been replaced only in one filter. No media problems have ever been observed.

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Again, there are no water quality parameters (e.g. turbidity) measured to specifically evaluate or control filtering operation.

Filtering Mode

During low lift pump operation, the 2 granular media filters receive equal quantities of flow at a constant rate. When one filter is backwashing, the other filter will accept the plant flow for the entirety of the backwashing period. Equal flow division resumes after the completion of backwashing.

Backwashing Mode

The backwashing sequence is initiated automatically at a 1.5 m head loss in the filter as a result of a pressure sensor and transmitter to the analog wall mounted valve controller. The sequence of backwashing events are:

1. 1.5 m head loss in filter.

2. The clarified influent water valve closes simultaneously with the opening of the filter drain valve, the backwash drain valve, and the closing of the transfer pipe valve.

3. The water drains from the filter to the top of the filter media, as controlled by a level probe. The maximum drain down time is 2 minutes.

4. The filter drain valve closes and the air scour valve opens.

5. There is an air scour for 2 minutes. If water drained down to the level sensor in drain down period (Step 3), the air scour will not occur.

6. The air scour valve closes; the transfer valve opens.

7. Water from the backwash storage compartment fills the filter compartment.

8. The backwashing period begins, utilizing water from the backwash storage tank and storage compartment. Backwashing occurs for 3 minutes.

9. The transfer valve closes, the filter drain valve opens, the backwash drain valve closes and the clarified water influent valve opens.

10. Clarified water rinses the media and exits via the filter drain pipe for 3/4 minute. It is unclear how the 3/4 minute rinse time was selected. Since the time appears to be somewhat short, it is recommended that an evaluation be done to optimize rinse time. This is discussed in detail in Section E.

11. The filter drain valve closes and the transfer pipe valve reopens.

12. Normal filtering operation resumes.

Figure D-2 illustrates the backwash cycle.

All of the backwash wastewater flows to the wastewater sump, and is subsequently pumped to the Deseronto WPCP for treatment.

D.3.f Granular Activated Carbon Contactors

Two granular activated carbon GAC contactors treat the filtered water for taste and odour control.

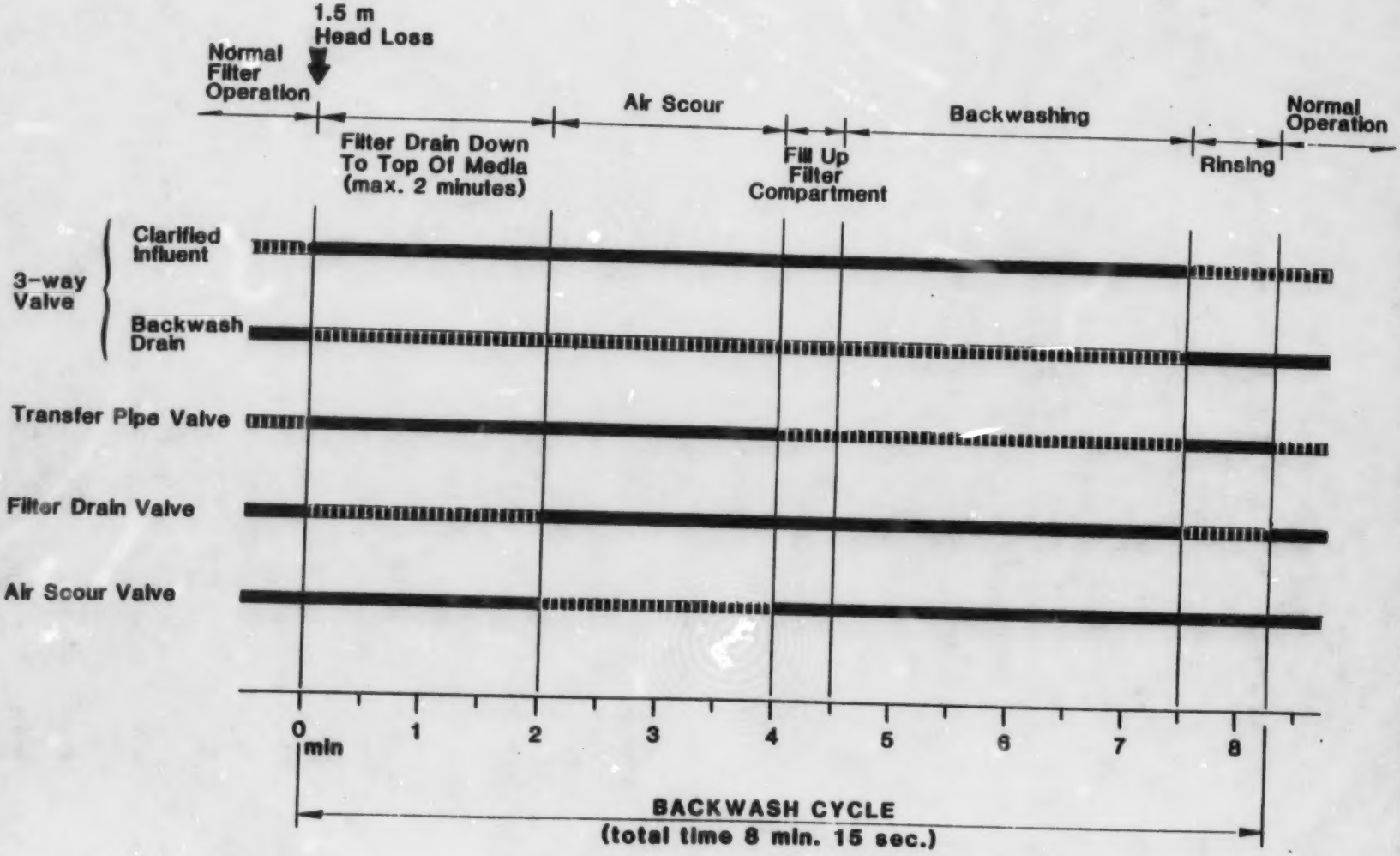

Figure D-2

SAND/ANTHRACITE FILTER BACKWASH CYCLE FOR DESERONTO WTP

Treatment

During low lift pump operation, the 2 GAC contactors receive equal volumes of the flow at a constant rate. When one contactor is in a backwashing mode, the other contactor will treat the entire flow until the treatment operation resumes in the backwashed unit. There are no water quality parameters measured for GAC contactor operational evaluation or control.

Backwashing of the GAC contactors is a manual operation, taking place once per week and more often in summer months. There are no specific factors used by the plant operators to indicate the necessity of backwashing. Backwash water is coloured (green/ brown) and turbid, with higher levels in summer months. This would indicate that the GAC contactor backwash is removing organic growth from the media, and possibly turbidity from the filtered water. Section E presents a discussion of this issue.
The backwashing sequence involves the following steps:

1. Filtered water influent valve is closed.

2. GAC treated water effluent valve is closed.

3. The backwash wastewater valve is opened.

4. The backwash water valve is opened.

5. Backwashing of GAC contactor continues for about 5 minutes, as timed by the plant operator. The end of backwashing is based on visual inspection of water clarity in the Tygon tubing.

6. The backwash water valve is closed.

7. The wastewater drain valve is opened.

8. Water left in the filter drains through the wastewater drain valve to the wastewater sump.

9. The backwash wastewater valve and the wastewater drain valve is closed.
10. The filtered water influent pipe is opened.

11. Normal GAC downflow operation begins.

All of the GAC contactor wastewater flows to the wastewater sump, and is subsequently pumped to the Deseronto WPCP for treatment.

D.3.g Chlorine Contact Chamber and Clearwells

The combined flow from both GAC contactors is conveyed via a 305 mm diameter pipe into the post chlorine contact chamber. Chlorine solution is added into the pipe before

water enters the chamber. Chlorinated water travels through the chamber and enters one of the two clearwells depending on the position of the valves.

The clearwells and chlorine contact chamber are of equal elevation and depth, resulting in a constant water level in the clearwell system.

The entire system is under the first floor of the plant. There are 2 access manholes. The concrete basins are not regularly inspected or cleaned.

D.4 CHEMICALS FOR TURBIDITY REMOVAL

Coagulant

The liquid alum is pumped at a constant rate of 125 mL/min (82 g alum/min) to the raw water flow, only during low lift pump operation, to apply a constant dosage of 40 mg/L in the raw water. This dosage has not been changed in the last 3 years of plant operation. The 40 mg/L dosage of alum was initially based on a number of jar tests done in 1983-1984. At the time of this study (February 1989) the applied dosage was still 40 mg/L.

In order to ensure a constant pumping rate, the flow is measured with a graduated cylinder and stop watch, and adjusted if necessary, at least twice per week. The 40 mg/L alum dosage is recorded daily on plant monitoring sheets (see Appendix I, Tables I-1, I-2). From this dosage and the daily raw water flow volume, the amount of alum used each day is calculated. The Plant Supervisor has found that this calculation accurately accounts for all alum purchased.

When necessary, the alum feedline is backflushed with plant supply water.

Coagulant Aid

A 0.15 percent Aquafloc 6465 solution is made up as needed, by mixing 1.36 kg of powder with 0.91 m^3 of treated water. When the solution is made up, it is mixed at high speed for about 5 minutes and then low speed for 4-6 hours with the LIGHTNIN mixer. During the period of mixing, the low lift pumps do not operate. The solution is pumped at a constant rate of 102 mL/min to the raw water after alum addition, to supply the target dosage of 0.08 mg/L.

Tables I-1 and II-2 summarize the Aquafloc dosages used at the plant in the study period. Dosages have remained steady in the range of 0.08 to 0.10 mg/L. The target dosage for these years was 0.08 mg/L based on jar tests done in 1983-84. As with alum, the chemical feed rate is measured with a graduated cylinder and stop watch and adjusted if necessary, at least twice each week. The calibrated dosage rate is recorded daily on plant monitoring sheets. From this dosage and daily raw water flow volumes, the weight of Aquafloc used each day is calculated. The polyelectrolyte dosage has not varied to the time of this study (February 1989).

The polymer feedlines are backflushed with plant supply water when necessary.

D.5 CHEMICALS USED FOR pH CONTROL

Lime or soda ash is added to the treated water before the final point of chlorine addition. It is desired to maintain a pH of about 8 in the treated water in order to avoid distribution system corrosion problems. Use of soda ash is more desirable because it is easier to handle and less messy. At present, the system is fed alternating bags of lime and soda ash in order to use up the supply of lime at the plant.

Presently the dosing rate is based on daily treated water pH measurements and is manually adjusted, as required, by increasing or decreasing the lime or soda ash solution pumping rate to the addition point in the treated water pipe leading to the clearwells. However, at present, the actual rates are not measured routinely. Average dosages are based on monthly lime or soda ash usage and total monthly flow.

The lime and soda ash dosages for the study period are summarized in Table I-1 (Appendix I). In 1987, the dosage rate of mixed lime and soda ash was constant, at a recorded rate of 0.5 mg/L for lime and 0.5 mg/L of soda ash. This resulted in a pH range of 7.1 to 7.9 in the treated water. In 1986, both lime and soda ash were added, in concentration ranges of 0.4-1.2 mg lime/L and 0.4-1.0 mg soda ash/L. The treated water pH in 1986 ranged from 6.7 to 7.5 (Note: only 6 months of data available). In 1985, only soda ash was used, at average dosages ranging from 2.0 to 5.2 mg/L (Note: only seven months of data available), resulting in pH values in the range of 7.0 to 8.0. It appears that the dosage has been inadequate, since the treated water pH rarely reached the target pH of 8.0. Recommendations for pH control are presented in Section F.

The lime slurry feed pumps run continuously despite the "start-stop" operation of the plant. This is done to avoid the feed line nozzle plugging that would result if the flow stopped and the lime desolubilized and hardened inside the feedline.

D.6 CHEMICALS USED FOR DISINFECTION

Chlorine gas is employed for disinfection at the Deseronto Water Treatment Plant. A pre-chlorination system exists at the plant, but has not been used since September 1986. For post-chlorination, a chlorine solution is injected into the treated water pipe before entering the chlorine contact chamber. The chlorine dosage has historically and is presently based on maintaining a sufficient free chlorine residual in the treated water to meet the demand in the distribution system. More specifically, a residual of 0.5-0.8 mg/L must be achieved at the plant in order to maintain 0.1-0.2 mg/L residual in the far reaches of the system. The chlorine dosage rate is adjusted daily, if necessary, to meet the above guidelines, subsequent to the total residual chlorine analyses. Although there is an online free chlorine residual analyzer, it is not used to control the chlorination process.

The dosage calculation is done at the same time each day for the previous day, and is based on the total raw water flow and the weight of chlorine used. The method does not account for the water wasted for backwashing of filters or GAC contactors and hence tends to result in underestimations of the applied dosage. The chlorinator operates during low lift pump operation, resulting in short periods after backwashing of high chlorine concentration, while the backwash storage tank is refilling. In other words, chlorine is added to treated water flow, but the dosage calculations are based on raw water flows.
Monthly dosages for the three year period 1985 to 1987 are presented in Table IV-1, and monthly disinfection data characteristics of seasonal variations are presented in Tables IV-2 for 1985 to 1987.

When the plant was pre-chlorinating (prior to September 1986), monthly average pre-chlorination dosages ranged from 0.5 to 1.7 mg/L, with an average concentration of 2.1 mg/L. The average free chlorine residual concentration, measured in filtered water, ranged from 0.1 to 0.2 mg/L. There was no marked seasonal variations in either dosages or residuals during this period.

In the pre-chlorinating period, monthly average post chlorine dosages ranged from 1.7 to 3.0 mg/L, resulting in free chlorine residual concentrations in the range of 0.38 to 1.5 mg/L in treated water. There was no seasonal variation in this data. It can however be noted from Table IV-2 that chlorine residual concentrations were very erratic on a day-to-day basis.

The plant discontinued pre-chlorinating because the same total chlorine residual could be achieved in the treated water at a lower chlorine cost. In the period September 1986 to December 1987, the average chlorine dosage (post) ranged from 1.82 to 3.09 mg/L. The corresponding average chlorine residual concentrations for this period ranged from 0.43 to 1.25 mg/L. As above, on a day-to-day basis, chlorine residual concentrations were somewhat erratic (Table IV-2). Section E presents a discussion of the disinfection process and recommendations for optimization.

D.7 ROUTINE MONITORING AND SAMPLING

The monitoring program at the Deseronto WTP includes daily sampling and analyses, and documentation of plant operating data.

Table D-1 summarizes the in-plant sampling and analysis program. All of the samples are drawn from the in-plant sampling lines described in Section C.5. Raw and treated water is analyzed daily for colour, pH, temperature and turbidity levels. In addition treated water is analyzed for total residual chlorine. A wall mounted Caltrol Analyzer provides constant monitoring of free chlorine residual in the treated water. A Lisle Metrix type of turbidimeter continually analyzes and records treated water turbidities. As mentioned previously, the results from the turbidity monitoring are not used for operational control of the plant.

Table D-1
DESERONTO WATER TREATMENT PLANT IN-PLANT MONITORING

Test	Sample Point	Frequency	Instrument
Chlorine Residual (free)	Treated water	Continual	Caltrol analyzer
Chlorine Residual (free & total)	Treated water Lab tap	Daily	Lovibond kit with DPD tablets
Colour	Raw water Treated water	Daily	Hazen DPD comparator
pH	Raw water Treated water	Daily	Fisher accumet pH meter
Temperature	Raw water Treated water	Daily	Thermometer
Turbidity	Raw water Treated water	Daily Daily	Turner designs Model 40 Nephelometer
Hardness	Treated water	Continual	Lisle Metrix DRT-200 with weekly circular chart recorder
	Raw water Treated water	Weekly	Titration
Alkalinity	Raw water Treated water	Weekly	Titration

In August 1988, the results from methods used at Deseronto WTP for measuring pH, residual chlorine and turbidity were compared to those from CH2M HILL equipment. All of the Deseronto methods were found to produce acceptable results. One deficiency of plant analytical procedures is the lack of turbidity standards to calibrate the meter to read turbidities in the normal range found at the plant. It is recommended that a complete set of standards be purchased in the range of 0.1 FTU to 10 FTU.

Plant operation information documented daily includes:

- Raw, treated and wastewater volumes
- Calculated weight of chlorine, alum, polymer used
- Calibrated dosages of chlorine, alum, and polymer
- Number of sand/anthracite filter backwashes and carbon contactor backwashes, and calculated water volume used for backwashing
- 5 minute settling volume of clarifier sludge

- Waste sump pump hours of operation, and calculated wastewater volume pumped

Information and results from the in-plant monitoring program are recorded daily on weekly monitoring sheets. This data is subsequently transferred on to the MOE Water Treatment Plant Utility Monitoring Spreadsheets, which are sent to the MOE SE Region office at Kingston at the end of each month.

Table D-2 summarizes the ongoing sampling that takes place at Deseronto WTP.

Table D-2
SUMMARY OF ROUTINE SAMPLING PROGRAMS AT DESERONTO WTP

Program Name	Location of Sample Analyses	Sampled Stream	Frequency of Sampling	Parameters Analyzed
UMIS[1]	Kingston Region MOE	• Raw water • Treated water	1/month	Colour, pH, conductivity, alkalinity, turbidity, chloride, hardness, Ca, Mg, Fe, F, SO_4
DWSP[2]	MOE LSB, Toronto	• Raw water • Treated water	1/month	Refer to Table I-3
Bacteriological	Kingston Regional MOE	• Raw water • Treated water • 4 locations at extremities of distribution system	1/week	Total coliform Fecal coliform Fecal strep.
Special Clearwell Samples	Kingston Region MOE	• Composite bottom & top sample from each clearwell	1/3 months	Total coliform Fecal coliform Fecal strep.

Notes: [1]MOE Utility Monitoring Information System
[2]MOE Drinking Water Surveillance Program

D.8 DAILY OPERATOR DUTIES

There are 3 personnel on duty during an 8 hour work day, who are responsible for the operation and maintenance of the Deseronto WTP as well as the adjoining WPCP. Plant staff duties performed by either the Supervisor, Operator or contract employee include:

1. Administration

2. Plant Operation
   - Response to alarms
   - Maintenance of chemical volumes for treatment

3. Routine Inspection

4. General Maintenance
   - General plant upkeep
   - Chemical solution preparation
   - Equipment cleaning, repair, adjustment
   - Seasonal maintenance programs

5. In-plant Monitoring Program
   - Sample collection
   - Lab tests
   - Chemical usage, dosage calculations
   - Documentation of performance parameters

6. Offsite Monitoring Program
   - Sample collection, preservation, packing and transportation

E. PLANT PERFORMANCE

E.1 FLOW CONTROL

The Deseronto WTP operates in an automatic start-stop manner. Low lift pump operation starts typically occur approximately six or seven times a day and operational periods are 45 minutes or longer. During winter, when water in the Town standpipe freezes and the operational volume is reduced, starts occur even more frequently resulting in shorter operational periods.

The transitional period from the beginning of low lift pump operation until steady state is reached has historically caused difficulty in controlling the sludge blanket and sludge wasting in the reactor clarifier. Furthermore, the effects of plant startup on clarifier turbidity removal and filter and GAC contactor operation in terms of turbidity breakthrough are undetermined.

In the following subsections, an experimental program to determine the effects of the start-stop plant operation on the various unit processes is presented. Subsequently, alternative methods of reducing the frequency of starts and stops or maintaining continuous operation to optimize plant operation and performance are presented.

E.1.a Reactor Clarifier

Start-stop operation can negatively effect the reactor clarifier turbidity removal ability if the sludge wasting process is not optimized. Flocculation within the blanket is expected to be worse during the startup period, and this problem is aggravated if there is too high a solids volume in the clarifier zone because the sludge blanket could rise and escape with the overflow during startup. Alternatively, insufficient solids in the reaction zone, caused by wasting too large a sludge volume, will result in poor turbidity removal because the blanket is too thin and flow distribution through it during startup is not optimal.

Controlling the sludge blanket level by desludging has historically been difficult due to the start stop operation of the Deseronto WTP. At present, the desludge timer automatically resets at the beginning of low lift pump operation and wasting occurs at this time and every set interval after this time. The sludge blanket drops during non-operating periods because continuous thickening is occurring. Wasting of the thickened sludge immediately after plant startup reduces solids concentration available for the reaction chamber.

The Deseronto WTP Supervisor has plans to implement on an experimental basis, an ultrasonic continuously monitoring level probe. The probe will be hooked up to the automatic desludge timer. Desludging will be activated at a pre-set high level and will stop at a pre-set low level. Because of the low solids concentration in the sludge blanket, there is a strong possibility that this type of probe will not recognize the sludge blanket interface. If this is the case, it is recommended a photoelectric probe found to be effective at other WTPs with EIMCO clarifiers, be installed for trial.

In order to optimize the desludging operation at the Deseronto WTP, a series of experiments are recommended. The experimental program should be designed by MOE or a contracted consultant. The re-establishing of the sludge blanket should be monitored to show how the blanket moves at plant startup. This test will show whether there is an initial billowing of light sludge which later settles or if the sludge blanket moves as a unit. These tests should include simultaneous monitoring at identical frequencies of clarifier effluent turbidity levels.

The proposed blanket monitoring testing methodology involves continuous monitoring of the sludge level in the clarifier for 20-30 minutes beginning at plant startup. In addition, samples of the clarifier contents at the three existing clarifier sampling points will be taken at 2 to 3 minutes intervals; and 5 minute settling tests to determine floc volumes should be performed for those samples. Simultaneously, turbidities in clarified water samples taken at 2 to 3 minute intervals (or continuously) should be determined. The tests should be performed over six to ten restart cycles in different periods of the year.

The experimental program results interpretation will be carried out be MOE or the consultant. For the period that the desludging operation continues to be automatic based on timing, it is recommended that the instrumentation be reconfigured so that the immediate desludging after low lift pump startup is eliminated. The above experimental results should be used to optimize the desludging interval and frequency, to maintain the maximum concentration of solids in the reaction chamber with the minimum height of sludge blanket.

If the continuously monitoring sludge level probe proves to be effective, the above experimental results may be used to optimize high and low levels for desludge control. In addition, if an initial sludge billowing effect is found, the results may be used to determine a timed delay for desludging to avoid premature wasting.

It is recommended that the described tests be repeated each season (quarterly) so that the system (either probe or timed automatic) can be optimized for the range of raw water qualities expected at the plant.

Subsequent to optimization of the sludge removal process, an experimental program designed by MOE or a consultant should be carried out to establish the effects of plant startup on the clarifier effluent turbidity. The proposed program will involve measuring clarifier effluent after startup and until the sludge blanket is reestablished. Either online turbidimeter results or measured turbidities in grab samples of clarifier effluent taken at a minimum frequency of one per 2 to 3 minutes can be used for these experiments. It is recommended that sampling continue from the beginning of the pump operation and for 20 minutes into the operating cycle. The completed results used to determine the effects of start-stop operation on turbidity removal in the clarifier will include the above test results for 6 to 10 restart cycles in different periods of the year. Detailed interpretation of results will be made by MOE or the consultant. This portion of the experimental program should be tied to the overall program recommended for the plant.

E.1.b Dual Media Filters and GAC Contactors

The dual media filters and the GAC contactors both function as filters for turbidity removal. During low lift pump operation startup, there is a possibility that light floc on the filter is stripped through the filter by the initial hydraulic surge. This would cause the initial filtered water turbidity to be high. After the initial surge, the turbidity levels would probably decrease.

There is insufficient monitoring data at the Deseronto WTP to determine if the hydraulic surge on the filters or contactors is degrading treated water turbidity. It is therefore recommended that a sampling program that will measure the effects be designed and undertaken by the MOE or a contracted consultant.

The proposed sampling program would involve collection of each filter and GAC contactor effluent immediately after low lift pump startup and for 20 to 30 minutes of operation. Sampling at 2 minute intervals is recommended for the full period and samples are to be analyzed for turbidity. The preferred alternative for turbidity measurements is the installation and utilization of in-line turbidimeters.

Tests should be done for a total of six to ten start cycles on the filters and the GAC contactors, at different times during the year. The interpretation of results from these experiments will be used in conjunction with the reactor clarifier results to select a methodology to control flows and optimize plant performance.

E.1.c Alternatives for Flow Control

Once the effects of the start-stop operation on clarifier, filter and GAC contactor performance have been determined, options for modifying the plant to optimize performance must be considered.

If the results from all of the tests show that there is no variance in turbidities in any of the process effluents, and sludge blanket control can be optimized, it is recommended that no changes take place in the automatic operation of the plant.

The most likely scenario is that the experimental program will reveal negative effects on treated water turbidities as a result of start-stop operation. In this case, optimization will involve reducing the frequency of low lift pumps starts, accomplished by increasing the length of operating intervals. The following alternatives should be evaluated:

1. The simplest way to lengthen the pump operational intervals is to throttle the low lift pumps to decrease the flow to the plant. Based on the historical flow data, the flows can be reduced significantly in the winter and to a lesser extent in the summer. Each time the flows are adjusted, the chemical feed pumps and chlorinator will require recalibration. The primary disadvantage to this alternative is the increased energy consumption of operating the pumps for more hours of the day without reducing the power consumption.

2. A second alternative for reducing the number of starts at the plant is to increase the operational volume in the treated water clearwells. This would result in longer low lift pump operating periods, and non-operating periods.

   Presently, the minimum level set for treated water storage capacity in the chlorine contact chambers and clearwell is 804 m^3 or 90 percent of the total volume. It is proposed that the low level probe in the clearwells that instigates low lift startup would be moved to say, 50 percent of the volume. This would still allow a constant volume 400 m^3 of treated water in storage in case of emergency (i.e. fire) and would reduce the number of starts per day to 1 to 2, one fifth of the present number.

3. Another way to improve the flow control operation is to implement a continuous flow system. A continuous flow configuration would require the following:

   - Variable speed drives on the low lift pumps, remotely indicated by a continuously monitoring level meter in the treated water clearwell.

   - Analog to pulse converters to send a signal to the chemical feed pumps and chlorinator to flow pace feed rates.

   The major disadvantage to this type of system is the capital cost. However, the operating and maintenance costs would not be higher than for the existing system.

It is recommended that the costs and benefits of each of the above alternatives be evaluated in detail by the MOE in conjunction with a consultant, once the effects of start-stop operation on plant performance has been determined.

E.1.d Summary of Recommendations

Prior to optimization of the flow control methods used at the Deseronto WTP, it is recommended that the effects of the present start-stop operation be established. It is therefore recommended that MOE or a contracted consultant design and perform an experimental program that will:

- Determine the effects of low lift pump startup on turbidity removal performance of the reactor clarifier, dual media filters and GAC contactors and on plant effluent quality.

- Determine the sludge blanket behaviour in the clarifier during plant startup.

If the experimental program results indicate that turbidity removal performance is poor for an interval after plant startup, then it is recommended that the following alternatives to reduce the number of starts be evaluated:

1. Throttle low lift pumps in the discharge line to reduce the raw water flow rate.

2. Increase the operating volume of the treated water clearwells.

3. Implement a variable speed, continuously operating low lift and chemical feed pump configuration, controlled by a continuously monitored treated water clearwell water level.

E.2 TURBIDITY REMOVAL

E.2.a Historical Turbidity Removal

Table E-1 presents a summary of the historical raw water and treated water turbidities at the Deseronto WTP, presented in Appendix I. As shown, turbidity levels have generally been below the MOE objective level of 1.0 FTU for drinking water. However, levels have infrequently exceeded the objective in the last few years. In addition, maximum monthly averages were greater than 0.7 for two of the three years of the study period.

Table E-1
SUMMARY OF HISTORICAL TREATED WATER TURBIDITIES AT DESERONTO WTP

Period	Turbidity (FTU)							
	Minimum Day	Maximum Day	Minimum Monthly Average	Maximum Monthly Average	Monthly Averages			
					January	March	July	October
1985	0.10	4.6	0.18	1.0	0.25	1.00	0.44	0.29
1986	0.20	1.9	0.15	0.56	0.50	0.56	0.15	0.31
1987	0.10	1.8	0.19	0.74	0.29	0.22	0.40	0.37
1988 (DWSP)	0.20	2.8	NA	NA	0.30*	0.60*	0.30*	0.30*

*Based on only one sample.

Table E-2 presents the results from additional turbidity measurements made on clarifier effluent and filter effluent samples in August-October 1988 and April 1989. As shown, raw water turbidities for all the samples ranged from 1.3 to 14.2 FTU. Clarified water levels ranged from 0.8 to 4.1 FTU, and averaged 2.1 FTU. In 70 percent of the samples, the filters did not remove the clarified water turbidities to below the Objective levels. The average filter effluent turbidity level was 1.3 FTU and ranged from 0.3 to 3.9 FTU. These data, although limited, suggest that the filter performance is the limiting process at the Deseronto WTP in providing good turbidity removal. Filter effluent turbidities for a well operated plant should average much below 1 FTU. The poor removal may be due to insufficient rapid mixing, unoptimized chemical dosages or the effects of start-stop plant operation (discussed in Section E.1). As shown, despite

Table E-2
TURBIDITY LEVELS IN RAW, CLARIFIED, FILTERED AND TREATED WATER AT DESERONTO WTP

Date			Turbidity (FTU)			
			Raw	Clarified	Filtered	Treated
August	3	1988	5.6	2.5	1.4	0.5
	5		3.8	2.3	1.5	0.7
	8		2.8	3.9	3.8	0.6
	10		8.5	4.1	3.9	0.4
	12		8.8	2.9	1.7	0.5
	15		9.1	2.4	1.2	0.5
	17		10.6	3.0	1.5	0.5
	19		7.7	1.9	0.8	0.4
	22		11.5	1.5	0.9	0.5
	24		9.2	4.1	1.9	0.4
	26		13.6	2.2	1.1	0.6
	29		15.4	2.0	0.9	0.8
	31		12.2	2.8	1.2	0.6
September	2		13.4	2.0	1.1	0.8
	7		14.2	2.4	1.1	0.6
	15		8.6	1.6	1.0	0.4
	20		13.6	3.2	0.8	0.4
October	11		4.3	2.8	1.4	0.6
	13		4.3	0.8	0.3	0.5
	18		3.1	2.3	1.4	0.3
April	4	1989	2.0	0.7	0.3	0.14
	18		1.3	1.2	0.3	0.17
	19		1.3	1.0	0.5	0.16
	21		1.7	1.1	0.4	0.16
Average			7.8	2.1	1.3	0.47
Minimum			1.3	0.8	0.3	0.16
Maximum			14.2	4.1	3.9	0.8

the high filtered water turbidities, treated water turbidities were always less than 1 FTU, indicating that the carbon contactors acted as an integral part of the turbidity removal process.

The turbidity removal efficiency should be improved. It should be noted that optimization of the plant flow control methods will probably be a major step toward optimization of the turbidity removal processes. The following discussion presents a review of each of the unit processes used for turbidity removal in terms of recommendations for process optimization.

E.2.b Chemicals and Chemical Dosages

In May 1989, a series of jar tests was carried out on raw water onsite. The test description is presented in Appendix V. A summary of the chemical dosages and results are presented in Table E-3.

Table E-3
RESULTS OF JAR TESTS PERFORMED USING DESERONTO WTP RAW WATER IN AUGUST 1988

Jar	Alum Dose (mg/L)	Aquafloc Dose (mg/L)	Final pH	Turbidity (FTU)	Al^{3+} Residual (mg/L)	Qualitative Comments		
						Floc Size[1]	Floc Density	Resistance to Hydraulic Transients[4]
1	15	0.1	7.1	5.0	-	medium	light	poor
2	15	0.2	7.09	3.3	-	large	light	poor
3	15	0.5	7.11	3.8	-	large	light	poor
4[2]	40	0.1	6.7	2.2	0.3	medium	dense	very good
5	40	0.2	6.7	1.8		medium	dense	good
6	25	0.1	6.97	2.2	0.65	small	medium	poor
7	25	0.2	6.99	2.2	0.65	small	medium	poor
8	50	0.1	6.67	1.2	0.35	large	dense	very good

Notes:
[1] small (1-2 mm), medium (2-4 mm), large (4-6 mm)
[2] Present plant dosages
[3] Raw water: pH = 7.02; turbidity = 7.0 FTU; temp. = 14°C
[4] Determined by movement of testing jar containing settled floc

Eight dosage combinations were used, including alum dosages of 15 to 50 mg/L and polyelectrolyte dosages from 0.1 to 0.5 mg/L. The results were evaluated based on turbidity and residual aluminum.

As shown on Table E-3, alum dosages below 25 mg/L produced very light unsettleable floc for all polymer dosages (0.1-0.5 mg/L). Dosages of 25 mg/L produce small floc for two polymer dosages (0.1 mg/L and 0.2 mg/L) that demonstrated poor resistance to hydraulic transients, as indicated from movement of the testing jars. At the present

plant dosage of 40 mg/L, a medium sized floc which settled well was produced, resulting in a settled water turbidity of 1.8 FTU and a residual aluminum concentration of 0.3 mg/L. Using an even higher alum dosage improved the turbidity removal to 1.2 FTU. However, the residual aluminum concentration increased to 0.35 mg/L.

The jar testing results indicated that at all concentrations, a fairly high residual aluminum concentration remains in the clarified effluent. It can be assumed that a portion of this is insoluble and will be removed in the filtering processes in the dual media filters and the GAC contactors. However, the DWSP data shows that treated water aluminum residuals were frequently greater than the 0.1 mg/L Guideline limit in 1988. It is likely that optimization of the turbidity removal processes at Deseronto WTP will result in significantly reduced treated water aluminum residuals. However, if these levels are still too high after optimization, pH control may be required, to optimize the floc formation process in the clarifiers.

It is important to note that while the jar tests can indicate an appropriate dosage combination, they cannot simulate the reactor clarifier performance. In the reaction chamber, the turbidity removal is by solids contact with a large concentration of solids. Since this situation can not be easily scaled down for laboratory testing, jar testing is an acceptable alternative. Comparison of the jar testing results to the clarifier effluent results for the same raw water are made below:

	Jar Test	Clarifier Effluent
Alum Dosage (mg/L)	40	40
Aquafloc Dosage (mg/L)	0.1	0.1
Turbidity (FTU) (effluent)	1.8	2.0
Al^{3+} Residual (mg/L) (effluent)	0.3	0.23

It has been shown that turbidity removal with alum is most effective at a pH of about 6. Therefore, if other methods discussed above do not result in an aluminum residual in treated water that is well below the limit, pH should become a variable in the optimization of chemical dosages through jar testing. At the Deseronto WTP, there is an unused chemical application point in the pipe to the clarifier prior to alum addition that could be used for acidification of raw water. However, if pH adjustment is required, a day tank and feed pump system would be required for the acid solution

(sulphuric acid), and additional lime or soda ash addition would be necessary after filtration to control corrossivity. Process monitoring of the chemical dosage process should involve three actions:

1. Regular calibration of the chemical feed pumps to ensure that the target dosage is being met. This is already being practised at a sufficient frequency (3-4 times/ week).

2. Regular measurement of clarifier effluent and final effluent residual aluminum concentrations.

3. Jar testing (according to MOE Jar Testing Protocol) at least four times per year, or when clarified water turbidities deteriorate or aluminum residuals in treated water increase. Turbidity removal and aluminum residual should be optimized using three variables: alum dosage, Aquafloc dosage and pH.

E.2.c Rapid Mixing

An online flash mixer exists at the Deseronto WTP but is not in use. The plant staff noticed no difference in the reactor clarifier performance when the mixer was shut off. However, turbidity levels of clarified water in both cases have never been measured or compared.

The calculated energy gradient values for flash mixing in the pipe to the reactor chamber are an order of magnitude less than typical values. However, since the reaction chamber provides slow mixing of raw water with chemicals with a high density of flocculated recirculating solids, the additional benefit of energy input from a flash mixing unit may be insignificant.

It is recommended that in order to optimize the flash mixing process, formal tests be designed and carried out by MOE or a contracted consultant. The tests will compare the water quality resulting from use of the flash mixer, to the water quality resulting from no mixing, so that the benefits of the flash mixing, if any, can be determined.

The proposed test program involves comparison of clarifier effluent turbidities under both conditions. In addition, filter effluent turbidities will be compared. The rationale for this is that floc size or strength may be affected with rapid mixing, which has an effect on filtration. Samples should be taken of clarified water and filtered water at regular intervals after low lift startup and until the end of an operating cycle, in order to characterize the clarifier effluent and the filtered water turbidity profile. The sampling will take place with no rapid mixing and will be repeated the next day (to ensure fairly constant raw water quality) with rapid mixing. The test should be repeated 6 to 10 times under various raw water quality conditions (i.e. at different times of the year). Results for each condition should be interpreted so that the differences in the turbidity profiles will be established.

It should be pointed out that prior to testing the rapid mixer state (either on or off) should be continuous for at least 6 hours of low lift pump operation (not necessarily continuous) in order to account for the hydraulic retention time in the reactor clarifier and filter.

It is recommended that the entire experimental program not be undertaken until after chemical dosages have been optimized. In addition, plant flow control and clarifier sludge wasting methods should be stable prior to beginning this program.

The results from these experiments should be interpreted by the MOE or consultant and used to evaluate the benefits of using the in-line flash mixing unit.

E.2.d Reactor Clarifier

Coagulation, Flocculation and Settling

As discussed in Section E.1, tests are recommended to determine how well the reactor clarifier unit is suited to the start-stop operation of the plant. Optimization of the process for turbidity removal will therefore involve optimization of the plant flow control methods, as well as of the reactor clarifier operation, chemical dosages and rapid mixing.

The turbine speed used for slow mixing and recirculating solids in the reaction cone was set 3-4 years ago after a number of trial and error settings. The speed setting has continued to provide good mixing and recirculating. Since raw water quality does change from season to season, and from year to year, optimization of turbine speed could be performed more frequently. Since, however, the present operation is trouble free, this is not high priority. Plant staff may want to consider experimenting with the speeds once all other factors have been optimized.

Sludge Blanket Control

Control of the sludge blanket to buffer the start-stop operation of the Deseronto WTP was discussed in Section E. Optimization of the desludging operation will result in a desludging frequency that will prohibit the blanket from rising above a high level and escaping over the effluent weir. Also, enough sludge will be kept in the clarifier at all times to maintain good turbidity removal by solids contact.

The speed of the sludge rake arm and scraper was set 3-4 years ago, in a trial and error experimental program. Since the scraper appears to be functioning as it should, it is not recommended that changes take place at this time. However, the plant staff may want to consider experimenting with speeds once all other factors have been optimized.

Process Control

In the past the plant staff have relied on visual examination of the clarified water and treated water turbidities for process monitoring. This has not allowed an ongoing record of the performance of the reactor clarifier process as a single unit.

Maintaining a continual awareness of the clarifier performance will allow prompt response to the need for chemical dosage re-evaluation with changing water quality. In addition, the dual media filter operation is affected by the clarified water turbidities. It is therefore recommended that the clarified water turbidity be monitored on a routine basis. The most accurate and effective technique used to routinely monitor is using an online turbidimeter with a recorder. This will allow around the clock monitoring of clarifier performance without requiring significant manpower. In addition, the continuous record will allow the experimental program recommended for the evaluation and optimization of flow control methods (in Section E.1) to be carried out with ease.

Presently, the plant staff control the desludging operation using daily 5 minute settling test results done on sludge from the recirculating chamber. It is recommended that this monitoring be continued, as it has proven effective in the past in setting the desludge frequency and interval.

Because the plant operation will continue to be automatic, it is also recommended that an alarm be used to signify poor clarifier performance. If a level probe is found to accurately detect the sludge blanket interface, an alarm can be used to indicate a high sludge blanket level. Alternatively, the online turbidity meter should activate an alarm when turbidity levels rise enough in the clarifier effluent to indicate slurry carryover the effluent weir.

E.2.e Dual Media Filters

Filter Media

During the time of this study there was limited information about the media in the dual media filters. The MOE planned to do a core sample of this media. However, results were not available at the time of this study.

The recommended media sizing is as follows (Ref. 2):

Sand	-	Uniformity coefficient: 1.5 Effective size: 0.45 - 0.55 mm
Anthracite	-	Uniformity coefficient: 1.5 Effective size: 0.8 - 1.2 mm

However, many different sizes of media falling outside this range can also function effectively. Media replacement is required if either turbidity removal is poor or the media cannot be properly cleaned by backwashing. Visual inspection of media indicates the latter is not a concern at Deseronto WTP.

At Deseronto WTP, a number of factors may be contributing to the poor turbidity removal efficiency exhibited by the filters, including start-stop operation and filter operation. It is therefore recommended that these factors be optimized prior to evaluating the need for replacement of the media. If the performance of the filters is still poor subsequent to optimization of these other factors, then media replacement should be considered.

For process monitoring, it is recommended that the media continue to be inspected once per year. Furthermore, it is proposed that core samples for media inspection and for sizing be taken annually.

Filtering

The data presented in Table E-2 show that the filtering process is not removing turbidity to a level expected for well operated dual media filters. The effects of start-stop operation on turbidity removal in the dual media filters was discussed in Section E.1. Once the surge effects on the filters has been determined, a number of alternatives that were presented in Section E can be considered for reducing the number of starts at the plant.

If the surge effect is found to significantly degrade effluent quality for a period of time, one filter alternative can be considered. This is:

- At the start of low lift pump operation, the filtered water is drained to the wastewater sump for an initial period presently set at 3/4 minute. This initial period length would be extended to last for the entire interval that filter effluent turbidity levels were high after plant startup. The feasibility of this alternative is dependent on how long the high turbidity persists after plant startup. In addition, the benefits must be compared to the cost of the additional volume of waste and the waste handling and storage capacity.

  For example, if a volume of water equivalent to the filter compartment volume was wasted at each plant startup, a total of 17.8 m^3 would be wasted. Assuming 6 starts per day, this is a total of 76.8 m^3 or 5 percent of the average daily raw water flow (in 1987). This compares to about 0.3 percent of the flow resulting for the existing 3/4 minute rinse following backwash.

Critical to the optimization of filter operation, three factors require consideration. These include:

- the terminal head loss setting
- the surge effect of a clean filter coming online after backwashing and rinse time setting
- The surge effect of the high flow rate through one filter while the other is backwashing

It is recommended that an experimental program be designed and undertaken by MOE or a consultant to evaluate and optimize these factors. The experimental protocol involves characterizing the turbidity profile in filtered water from each filter over a number of low lift pump operational cycles. The monitoring should continue over six to ten backwash cycles. Interpretation of the results should be done by MOE or the consultant.

If there is a large increase in turbidity levels in filter effluent prior to backwashing, the terminal head loss of 1.52 m should be decreased. The experiments should be repeated until the head loss setting instigates a backwash before turbidity breakthrough.

If the experimental program results show that there is a slug of highly turbid water exiting a filter immediately after backwashing and coming back online, then the filter to waste time should be increased. It is recommended that the experimental program be repeated to optimize the rinse time.

Results may show that twice the normal flow rate through one filter that occurs while the other is backwashing may be high enough to strip particles through the operating filter. This water would flow to the backwash water storage tanks and although some would end up as washwater, some would flow through the GAC contactors and into the treated water. In addition, once normal flows resume to both filters, a period of high turbidity may result, as discussed above.

If this hypothesis holds true, the following alternatives should be considered:

1. Automatic low lift pump shut down during filter backwash. If terminal head loss is reached when the clearwell is at a low level, the shut down during the backwash cycle time of about 7-3/4 minutes may result in a low clearwell water level alarm. Therefore, for this alternative to be considered, a timed delay of 17.5 minutes on the low level alarm must be implemented or else a volume of 37 m^3 must be allowed between the low level switch that starts the low lift pumps and the alarm level. It should also be noted that the backwash flow rate will be decreased with this alternative. Because a continuous flow of water will no longer enter the backwash water tank from the operating filter during backwashing, the static head in this tank will decrease more quickly, thereby reducing the average backwash flow rate.

2. Alternatively, one low lift pump could be shut off during backwash. Thus, the flow would not increase through the second operating filter and there would be no surge effect.

3. Rearrangement of the piping such that the high flow rate through the non-backwashing filter would be used as GAC or filter backwash water only. This is a complicated alternative that would require a complete hydraulic analysis and engineering design.

Presently, there is no routine monitoring of filter performance. It is recommended that turbidities in clarified water to the filters and filtered water from each filter be monitored. As mentioned, the most accurate and effective and least labour intensive technique used to routinely monitor turbidity is an online turbidimeter with recorder. It is recommended that the turbidity records be examined by plant staff daily, so that media problems, equipment malfunctions, and other performance or operational problems are detected promptly. The continuous record will also allow ease in performing the recommended experimental programs.

Backwashing

Based on the backwashing rate and the condition of the media (i.e. no mudballs) the filter backwashing appears to be sufficient. It is recommended that the plant staff inspect the backwash water using a method similar to the one used for the GAC filter, to ensure that the backwash water runs clean before the backwashing interval is finished. This inspection should take place once each season (quarterly) and the length of the backwash cycle should be increased or decreased accordingly.

E.2.f GAC Contactors

The GAC contactors were installed at the Deseronto WTP for taste and odour removal. However, since these processes also have a capability to remove turbidity, they should also be considered an integral part of the turbidity removal process. The following subsections present the recommendations for optimization of the GAC contactors for turbidity removal performance.

GAC Media

The media presently in the GAC contactors is Filtrasorb 400, with effective size, according to the manufacturer, of 0.65 mm. The size of this media is within an acceptable range for turbidity removal.

Filtering Operation

Determination of terminal head loss pressure that signals the need for backwashing is critical to the optimization of the GAC contactors for turbidity removal.

Before an experimental program can be undertaken, pressure gauges are required on the contactors to measure the differential pressure across the media bed. The proposed experimental program will involve characterization of the turbidity profile in the GAC effluent over a number of low lift pump operational cycles. The terminal head loss will be established at turbidity breakthrough. The experiments should be repeated for each filter 3 to 5 times.

It is recognized that there may be a turbidity surge effect due to low lift pump startup and again, to the GAC contactor handling the total flow while the other is backwashing. However, because the GAC operation is manually controlled, there are no existing options available to reduce this effect. The best way to improve GAC contactor effluent turbidity is to reduce the turbidity loading to these units. This will be done in the optimization of the chemical dosages, reactor clarifier operation and especially, the dual media filter operation.

It is recommended that process control for turbidity removal be based on continuously monitored turbidity levels from online turbidimeters on each GAC contactor. These records should be examined daily be plant staff. In addition, the pressure gauge on each contactor should be connected to an alarm. The alarm will initiate when head loss in one or the other filter is approaching the terminal level.

GAC Contactor Backwashing

The condition of the media in January 1989 (i.e. no mudballs, etc.) indicated that backwashing has been adequate. The backwash rate is slightly higher than the media manufacturer's recommended range. The methodology used to determine backwash length (i.e. examination of backwash water in clear plastic tubing) has proved to be effective, and should be continued.

E.2.g Summary of Recommendations

Recommendations made to optimize the turbidity removal performances of the various unit processes are the following:

- It is recommended that jar testing using MOE Jar Testing protocol be carried out seasonally (quarterly) to optimize chemical dosages.
- It is recommended that an experimental program be undertaken to determine if clarified or filtered water turbidity levels can be reduced if the rapid mixing unit was used.
- An online turbidimeter with recorder on the clarified water stream is recommended for turbidity monitoring and process control.
- It is recommended that the 5 minute sludge settling tests be continued to control the desludging operation. In addition, a high sludge blanket level in the clarifier should be alarmed.

- Visual inspection of media core samples of media in the dual media filters is recommended annually to determine if mudballs, etc. are present.

- An experimental program is recommended to optimize the terminal head loss, rinse cycle length, and operation of the dual media filters. In addition, an initial filtering to waste period at low lift pump startup, if deemed necessary, can be optimized in the same program.

- It is recommended that in-line turbidimeters with recorders be installed to monitor dual media filter effluent streams, and records be examined daily by plant staff.

- Visual inspection of the dual media filter backwash water on a quarterly basis is recommended, to ensure that the backwash cycle is of sufficient length.

- It is recommended that the GAC contactors be considered an integral part of the turbidity removal process, and therefore be equipped with pressure gauges to measure pressure head loss across the media bed, and turbidimeters with recorders on the contactor effluent streams for process monitoring and control.

- An experimental program is recommended in order to determine terminal head loss and backwashing frequency of the GAC filters for optimal turbidity removal performance.

E.3 TASTE AND ODOUR REMOVAL

E.3.a Dioxin and Furan Compounds Detected on GAC Media

The GAC contactors at both Deseronto and nearby Odessa WTP had been in service for about seven years when it was decided in October 1987 that the media be replaced. At this time, a MOE Water Resources Branch/SE Region joint research study was initiated to investigate the kinds of substances that might be retained in GAC contactors after a long period of service. Samples of the GAC media were collected and taken to MOE Laboratory Services Branch for organic and inorganic characterization. Although no recognized standardized analytical protocol existed for GAC media, dioxin was analyzed on carbon removed from each of the contactors at both WTPs.

Analytical results from the first samples (October 1987) showed that various dioxins and furans could be detected on the carbon. Tetrachlorodibenzodioxins were present at the highest concentrations. However, no 2,3,7,8-tetrachlorodibenzodioxin was found. The levels of total dioxin/furan compounds were less than those typically detected in soils.

On January 6, 1988, additional samples of unwashed GAC media were collected for further analyses. Due to the increased sensitivity of the analytic equipment, enabling lower detection limits, congener groups were detected at this time that were not found previously. However, although confirmed present, concentrations were so low (10-12 g/g range) that levels of these additional compounds could not be quantified. The tetrachlorodibenzodioxin concentrations were similar in this test to the previous tests.

Subsequent to the media analysis, samples of unused GAC media, raw and treated water (January 22, 1988), and GAC backwash water (January 22, 1988) were collected and analyzed for dioxin/furan compounds. None of the compounds were detected in any of these samples above the detection limits.

Based on the experimental results it can be concluded the dioxin/furan compounds were present on the GAC media. However, results indicate a possible worst case tetrachlorodibenzodioxin concentration in water treated without GAC of approximately 10-12 g/L, which is well below the proposed interim maximum acceptable concentration (I.M.A.C.) for drinking water. Therefore, levels in GAC treated water would be substantially less than the IMAC level.

There are two possible reasons for the presence of dioxin/furan compounds on the GAC media. The first is that the compounds are present in raw water, either from a natural non- industrial source or from an industrial source. Although some dioxins are naturally occurring (such as octachlorodibenzodioxin) tetrachlorodibenzodioxin compounds, if in the raw water, are contributed from other sources because they are not known to be naturally occurring. One argument against this theory is that the Odessa WTP receives its water supply from a small creek, with no upstream, industrial contributors. Furthermore, raw water samples from both plants did not contain dioxin/furan compounds. This argument should be used with caution because the database is very limited (i.e. based on one sample from each plant). There remains open the possibility that the presence of dioxin/furan compounds in raw water is episodic. Nevertheless, based on the available information and engineering judgement, it is not likely that these compounds were of industrial or natural origin.

This leads to a second explanation, that is, that the compounds were formed on the GAC media. A number of researchers have studied the reaction of free chlorine with adsorbed compounds on GAC media. In one study, free chlorine was found to react readily with a group of adsorbed phenolic compounds to produce a number of compounds, including PCB's, that would not be formed in solution (Ref. 4). In another study (Ref. 5), free chlorine reactions with organics on the GAC resulted in formation of hydroxylated PCBs. These studies suggest that there is a possibility for the formation of other compounds such as dioxin, under the same conditions. At Deseronto, a pre-chlorination process existed until mid-1986, while at Odessa, pre-chlorination is ongoing.

However the other compounds came to exist on the media, the significance of their presence is of utmost concern. If the compounds entered the contactors or were formed within, whether they can pass through into the treated water is of primary concern. One study (Ref. 6) showed that many compounds formed on GAC media were strongly adsorbed (e.g. 4-4'-dihydroxybiphenyl), whereas other products (e.g. p-benzoquinone) were displaced by the introduction of a strongly adsorbed compound. Dioxin/furan compounds are known to be highly insoluble and hydrophobic. For example, 2,3,7,8-tetrachlorodibenzodioxin has a solubility of 2.05 x 10-5 mg/L and Kow of 6.64 (greater than 5 indicates very hydrophobic) (Ref. 7). This suggests that dioxin compounds are strongly adsorbed to the GAC media and would not likely be present in either backwash water or treated water.

We recommend an experimental program to test two hypotheses:

1. The dioxin/furan compounds were formed on the GAC media through a reaction between free chlorine and adsorbed organic molecules.

2. The dioxin/furan compounds are strongly adsorbed to the GAC media, and will not be released to the treated water.

To confirm the first hypothesis, homogeneous samples of the GAC media from both contactors at Deseronto and from the Odessa WTP contactor, should undergo dioxin/furan analyses. As noted, Deseronto WTP has not had pre-chlorination of raw water since new media replaced the seven year old media, but Odessa has continued pre-chlorinating. If the hypothesis were true, dioxin/furan compounds would only be present in the GAC media from Odessa WTP.

The second hypothesis may be tested at Deseronto WTP only if dioxin/furan compounds were detected on the media. This would involve analyzing the dioxin/furan compounds at various depths in a core sample of the media. It is recommended that a core sample of the media be taken, and divided into 3 or more layers. Each layer should be analyzed separately. If the results indicate that dioxin/furan compounds are found only in the top layer, or they are at much higher concentrations in the top layer than in succeeding layers, it is likely that the compounds remain adsorbed to the original solid to which they attach, however they enter the adsorber. If, however, the concentrations are homogeneous over the media bed, it would suggest that the compounds are moving through the contactor and can pass into the treated water. The rate of this movement, however, may be so slow that desorption of compounds into treated water may only occur after a number of years.

Based on the results from both Odessa and Deseronto GAC media analyses, a re-evaluation of the role of GAC at Deseronto should be made. Consideration should be given to the levels of dioxin/furan type compounds that might appear in treated water if the GAC is not used compared to the levels that might be present, if any, when GAC is used. Consideration should also be given to the pretreatment processes that might affect its performance. If dioxin/furan compounds are in the raw water and they are adsorbed, a seven year replacement frequency may be too long. If these compounds

are shown to be formed by chlorine-adsorbed compound reactions on the GAC surface, dechlorination, with sulphur dioxide, for example, may be necessary if pre-chlorination is ever to be re-instituted.

E.3.b GAC Contactor Process Control

As previously described in Section C., the media, surface loading rates and empty bed contact time at design flows are appropriate for taste and colour removal at Deseronto WTP.

At present, there are no formal process control methods used to determine when the GAC media has exhausted its capacity for taste and odour removal. If a problem does occur in the treated water quality, then plant staff is informed by telephone calls from the resident who perceives the problem. Prior to changing the media in 1988, complaints regarding taste and odour were attributed to household hot water tanks and not treated water odours.

Replacement of the media in 1988 was not instigated by taste and odour breakthrough into treated water. Therefore, the lifespan of the media for effective taste and odour removal is unknown. In order to optimize the taste and odour removal process it is recommended that process control measures be initiated.

The TOC levels in filtered water and GAC treated water were considered as control parameters. However, because the GAC media exhausts its ability to remove TOC long before its taste and odour removal capability is exhausted, this option was ruled out.

Another alternative was the use of iodine numbers as process control parameters. This would involve measurement of iodine number on clean GAC media, and on GAC samples taken from the adsorber throughout its life. Subsequently, a relationship would be developed between iodine number and threshold odour over a long term. Using the correlation, the remaining life of the GAC at any time, GAC could be determined by measuring the iodine number on a media sample. This alternative was deemed inappropriate for Deseronto WTP.

The long life span of the media would not allow a useful application of process control for many years. In addition, the level of effort required from plant staff of a plant this size does not warrant this method.

The process control method most applicable to Deseronto WTP involves measurement of threshold odour numbers. To detect deteriorated odour removal efficiency, threshold odour numbers should be established by a selected panel of not less than 3 individuals at seasonal intervals (quarterly). Tests should be conducted at a location away from the WTP site, and in accordance with the methods described in Standard Methods (Ref. 8). If threshold odour numbers indicate ineffective odour removal, GAC media should be replaced.

It is also recommended that staggering GAC media replacement in the two contactors begin. This will leave one contactor with "clean" media to continue to treat the entire flow while the other contactor media is replaced. By staggering replacement, more flexibility will be available in the taste and odour removal process. Comparison of samples from the older and newer media will allow another measure of odour for the panel.

At Deseronto, GAC media was replaced in both contactors in January 1988. Since the life span of the media is unknown, but the original media appeared to outlast seven years, it is recommended that media be replaced in one filter after 3-1/2 years, or in mid-1991. After this time, media should be replaced as needed, indicated by the threshold odour numbers in samples from each of the filters.

E.3.c Summary of Recommendations

In order to confirm that there is no health risk associated with the presence of dioxin/furan compounds found on GAC media samples taken in January, an experimental program is recommended that will:

- Determine whether the compounds are formed on the GAC media as a result of a reaction of free chlorine with adsorbed organic substances.
- Determine whether the dioxin/furan compounds have potential to desorb from the media and release into treated water.

In order to optimize the taste and odour removal process, it is recommended that process control measures be initiated. These include:

- Quarterly threshold odour number measurements by a panel of 3 or more individuals.
- Staggering of GAC media replacement between the contactors.

E.4 DISINFECTION

E.4.a Summary of Disinfection Operation

The bacteriological testing results for 1985 to 1987 are presented in Table II-1, and for 1988 (DWSP) are presented in Table II-2, Appendix II. The historical data show that total and fecal coliform and fecal streptococcus were absent in every treated water sample submitted, except one in January 1988. These data indicate that disinfection has been sufficient to reduce the bacteria levels in treated water to the MOE Objective levels.

The disinfection data presented in Appendix IV is summarized in Table E-4. As shown, since 1987 the free chlorine level has been greater than 0.1 mg/L in daily treated water samples. Data for 1988 show that there was a free chlorine residual in all samples from both distribution system sampling locations.

Table E-4
SUMMARY OF FREE CHLORINE RESIDUAL CONCENTRATIONS IN DESERONTO WTP TREATED WATER AND DISTRIBUTION SYSTEM

Year	Free Chlorine Concentration (mg/L)					
	Treated Water		Distribution System			
			Standing		Free Flow	
	Minimum Day	Maximum Day	Minimum	Maximum	Minimum	Maximum
1985	0	1.9	-	-	-	-
1986	<0.1	2.5	-	-	-	-
1987	0.1	1.6	-	-	-	-
1988	0.3	1.1	0.1	0.3	0.4	0.8

The Deseronto WTP Supervisor reports that there is no known problem with bacterial growth within the distribution system. The historical data indicate that there is sufficient chlorine concentrations in the treated water to meet the demand in the distribution system.

As previously discussed, pre-chlorination was discontinued at Deseronto WTP in 1986, because the same treated water free chlorine residual could be achieved using significantly less chlorine. Since pre-chlorination was discontinued, there have been no problems within the treatment plant. In addition, there is sufficient chlorine contact time in the chlorine contact chamber and clearwell.

The theoretical concentration-time (Ct) values were compared to the existing disinfection system at Deseronto WTP to ensure that disinfection is sufficient without pre-chlorination. Several sources state that disinfection should be enough for a 3 log inactivation of Giardia and a 4 log removal of enteric virus. It can be assumed that at least 2 log removal of Giardia and 1 log removal of enteric viruses takes place in the treatment process. Based on these assumptions, and a residual chlorine concentration of 0.8 mg/L required for the Deseronto raw water, the Ct values are as follows (Ref. 9):

pH	Ct at 1°C	Ct at 27°C
7.5	89 mg/L * min	10 mg/L * min
8.3	126 mg/L * min	14 mg/L * min

There are presently 83 minutes of contact time in the baffled plug flow chambers, and an additional 6.2 hours in the clearwells. At the typical chlorine dosage of 1.9 to 3.1 mg/L, there is more than adequate contact time at the plant for disinfection. At present the chemical application point for pH control is just seconds downstream of the chlorine dosage point, resulting in an increase in pH during chlorine contact. As shown by the above values, a higher Ct is required as the pH increases. Therefore, better disinfection can be achieved if the pH is kept low for the entire contract period. Based on this argument, it is recommended that the application point for the chemicals for pH control be moved to after the chlorine contact and clearwell chamber. This is discussed in more detail in Section E.5.

It is recommended that the existing disinfection method of post-chlorination continue. If the raw water quality changes, however, a pre-oxidant may become necessary and re-evaluation is recommended.

E.4.b Total Trihalomethanes

Total trihalomethanes (THMS) are formed in water by the reaction of chlorine with humic organic substances in raw water. The existing MOE Objective maximum level of total THMs in drinking water is 350 mg/L. The 1988 DWSP data in Table I-3 shows that total THM concentrations in treated water ranged from 0.2 to 131 mg/L.

The available data show that total THM concentrations are well below the MOE objective level. In addition, optimization of the turbidity removal processes in the plant could potentially reduce these levels further. Because there is a positive correlation between pH increase and THM formation, if treated water pH were increased for corrosion control purposes, the THM formation will increase. The THM levels should be monitored to ensure that the Objective is still being met.

If the MOE total THM Objective becomes more stringent, a number of alternatives are available to reduce the concentration in treated water. These include:

1. Ammonia added to the treated water has been shown to significantly reduce the formation of total THMs. The ammonia readily converts the free chlorine to chloramine, which cannot undergo rapid reaction with humic substances to produce THMs. Therefore, ammonia could be added to the water stream prior to post-chlorination at the Deseronto WTP, to reduce the total THM concentrations.

2. The existing and recommended coagulation process control parameter is turbidity. In order to reduce the humic substances, the coagulation process can be optimized for TOC removal. In this case, TOC would require monitoring on a routine basis for process control.

3. The GAC filters could be operated for TOC removal. It has been shown that the life of GAC for THM precursor removal is much shorter than the exhaustion time for taste and odour removal, and can be as short as 3 to 4 months. Therefore, this alternative could be very costly, depending on the degree of TOC removal required.

E.4.c Process Control

As previously described, the target range of free chlorine residual concentrations is frequently not met. The Plant Supervisor finds that dosage control difficult because the rotameter flow meter controlling the chlorine solution flow is not easily fine tuned. In addition, the low lift pump start, which starts the chlorine feed, may cause slight changes in the adjustments.

One method for improving chemical dosage control will be to reduce the number of low lift pump starts, as discussed in Section E.1. More control could be achieved by implementing an automated control system, where dosage would be adjusted automatically depending on the treated water residual. However, because there has historically been sufficient free chlorine residuals in the distribution system, the cost of an automated system is not warranted.

Control of the disinfection process and chlorine dosage rate has historically been based on the free chlorine residual measured in daily treated water samples, and the free chlorine residual in monthly distribution system samples. In 1988, total chlorine was also measured in these samples. It is recommended that the dosage control continue to be based on maintaining the target dosages of free and total chlorine residual concentrations in both treated water samples and distribution system samples.

In addition, because the plant must continue to operate automatically, it is recommended that the existing online free chlorine analyzer signal an alarm in emergency situations. A free chlorine residual of 0.2 mg/L in treated water is recommended as the low level alarm concentration.

E.4.d Summary of Recommendations

In order to optimize disinfection at the Deseronto WTP, the following recommendations were made:

- The practice of not pre-chlorinating should be continued until such time that the raw water quality changes to warrant a pre-oxidant.

- The total THM data show that treated water concentrations are presently well below the MOE Objective. If the Objective becomes more stringent, alternatives should be evaluated that will reduce the THM levels in treated water.

- Both free and total chlorine in raw and treated water should be monitored daily and recorded on routine monitoring sheets.

- Chlorine dosage control should continue to be based on maintaining a target residual in the far ends of the distribution system and in the treated water.

- The online free chlorine analyzer which continuously monitors free chlorine residual should be alarmed at a low level of 0.2 mg/L.

E.5 pH ADJUSTMENT

E.5.a Target Dosages of Chemicals for pH Adjustment

Lime and/or soda ash has been and is being added to the treated water to prevent corrosion of distribution system pipes. Table E-5 presents a summary of the historical treated water effluent pH values.

Table E-5
SUMMARY OF pH VALUE IN TREATED WATER

Year	Minimum Day	Maximum Day
1985	7.0	7.95
1986	5.1	7.7
1987	7.1	7.9
1988	6.6	7.7

The 1988 Langelier indices calculated for the DWSP data using the reported field pH are presented in Table E-6. These numbers were calculated using the Larson formula (Ref. 5). A negative Langelier index indicates that the water is undersaturated with calcium carbonate and could possibly be corrosive. The DWSP sample results presented in Table I-2 show that concentrations of copper, iron, nickel and lead are elevated in the distribution system standing water samples compared to the free flow or treated water samples. However, concentrations in all except one sample were well below the Guideline limits. Furthermore, there have been events of red water from certain sections of the distribution system. The Langelier index, in conjunction with the sample data, suggests that the Deseronto WTP treated water is somewhat corrosive.

Table E-6
1988 LANGELIER INDICES CALCULATED FROM DWSP SAMPLES

Month	pH	Alkalinity (mg/L as $CaCO_3$)	Calcium (mg/L)	Carbonate Saturation pH	Langelier Index
January	7.6	98.1	43.8	8.0	-0.386
	7.1	94.8	45.8	8.0	-0.882
	7.3	97.4	45.8	8.0	-0.721
March	7.6	88.4	39.8	8.1	-0.465
April	6.9	75.6	35.4	8.1	-1.237
May	7.2	79.4	36.4	8.1	-0.866
June	7.3	87.3	40.4	7.9	-0.586
July	7.1	87.9	42.8	7.8	-0.705
August	7.7	93	39.1	7.7	-0.032
September	7.0	78.7	39.6	7.9	-0.884
October	7.0	84.8	42.2	7.9	-0.886
November	6.6	86.5	40.0	8.0	-1.413

Based on the results it is recommended that the target pH be increased to produce a positive Langelier index in the treated water. Langelier's index shown in the following equation:

$$LI = pH - pH_s$$

Where pH = pH of treated water

pH_s = the pH at which calcium carbonate saturation will occur (calculated using the Larson formula, Ref. 8)

Where $$pH_s = A + B - \log [Ca^{2+}] - \log [Alk]$$

and A = Constant, dependent on temperature

B = Constant, dependent on total solids

$[Ca^{2+}]$ = Calcium concentration (mg/L) as mg/L $CaCO_3$

[Alk] = Total alkalinity as mg/L $CaCO_3$

Tables E-7 and E-8 present the values of A and B for the Larson equation.

Table E-7
CONSTANT A AS FUNCTION OF WATER TEMPERATURE (Ref. 8)

Water Temperature (°C)	A
0	2.30
4	2.24
8	2.18
12	2.13
16	2.07
20	2.01
25	1.93
30	1.86

Table E-8
CONSTANT B AS FUNCTION OF TOTAL DISSOLVED SOLIDS (Ref. 8)

Total Dissolved Solids (mg/L)	B
0	9.70
100	9.77
200	9.83
400	9.86
800	9.89
1000	9.90

As shown from the above equation, addition of lime will increase the calcium concentration and lower the pH_s value, thereby increasing the Langelier index. Alternatively, addition of soda ash will increase the alkalinity concentration and lower the pHs value, thereby increasing the Langelier index. It is therefore recommended that the lime or soda ash concentration in treated water be maintained such that the Langelier index will be equal to or greater than zero.

E.5.b Process Control

At present, lime or soda ash slurry is pumped continuously despite the start-stop operation of the plant. The dosage is calculated based on the total weight of chemical used per month and the total monthly flow. The lime or soda ash is applied prior to chlorine contact, resulting in reduced disinfection effectiveness. It was therefore recommended that this application point be moved to a point after the treated water

exits the clearwell. The most appropriate location for this application point is the distribution force main. The high pressure main will provide turbulence for mixing. Once the application point has been relocated, a greater degree of operational control can be achieved.

In order to maintain the target pH, the dosage of lime or soda ash required for a zero or positive Langelier index should be applied. The required dosage can be calculated using the above equations. Alternatively, Caldwell-Lawrence diagrams can be used for determining the dosage requirements. It is recommended that the plant staff become familiar with this approach through a series of articles that were prepared specifically for plant operators (Ref. 10).

For process control, it is necessary to determine the pH of the water after chemical addition. It is therefore necessary to implement the chemical addition point upstream of the existing treated water sampling point and online pH monitor in the treated water distribution main. Alkalinity and calcium analyses should be done at least once per week, and the chemical dosage should be adjusted accordingly.

It is recommended that soda ash be used as the pH adjustment chemical at Deseronto WTP. In order for this dosage control method to be utilized, chemical feed pumps must be reconfigured to operate simultaneously with high lift pumps. Using this configuration, the actual dosage to the treated water may be calculated and the process control methods may be applied rigorously to ensure a high degree of pH control.

When the existing supply of lime at the plant has been depleted or when the dosage point is moved, it is recommended that the static mixer in the pipe leading to the chlorine contact chamber be removed and cleaned. It is likely that a large calcium carbonate buildup has occurred due to constant lime application during no flow periods.

E.5.c Summary of Recommendations

In order to optimize the pH adjustment process, with respect to corrosion control in the distribution system, the following recommendations were made:

- The chemical application point should be moved to the distribution main upstream of the pH meter and treated water sampling point. The feed pumps should be reconfigured to operate only during high lift pump operation.
- A target chemical dosage to achieve a zero or a positive Langelier Index should be maintained.
- For process control, pH, alkalinity should be monitored in lime or soda ash treated water and calcium in lime treated water, and the dosages should be adjusted accordingly.

- Soda ash is the recommended chemical for pH adjustment after depletion of the lime.

E.6 OTHER

A number of other items require consideration in the optimization of the Deseronto WTP. Each of these items are discussed below.

E.6.a Flow Meters

The venturi flow meters which measure raw water and treated water flow rates are equipped with mercury manometers. These flow meters are directly connected to the drinking water supply, and therefore impose a risk of contaminating the water. It is therefore recommended that the manometers be removed. Louck DP cell calibrators may be used for flow meter calibration during annual service checks.

E.6.b Laboratory Equipment

As presented in Section D, the laboratory equipment and methods used for measuring routine parameters at the Deseronto WTP are adequate. However, there are insufficient turbidity standards to measure the full range of turbidities entering the plant. It is therefore recommended that the laboratory be supplied with standards in the range of 0.1 to 10 FTU.

E.6.c Documentation of Routine Monitoring Parameters

The routine plant monitoring parameters listed in Table D.1 and plant operational data (pg. 54) have not always been measured and/or recorded in the past. Since 1987, however, documentation of these parameters has been done on a regular basis. It is recommended that the routine monitoring and documentation program continue, and every effort be made to record all necessary information without exception.

F. SUMMARY OF RECOMMENDATIONS

A number of recommendations were outlined in Section E for optimization of the Deseronto WTP in terms of flow control, turbidity removal, taste and odour removal, disinfection and distribution system corrosion control. These recommendations can fall into one of the following categories:

- Studies
- Equipment or Process Modifications and Requirements
- Operational Changes

It should be noted that the recommendations contained in this report may have been completed at the time of preparation. The recommendations for the Deseronto WTP are summarized according to these three categories in the following subsections.

F.1 STUDIES

It was recommended that a number of experimental programs be undertaken to develop a better understanding of the factors affecting turbidity removal at the Deseronto WTP so that turbidity removal processes can be optimized. It is recommended that these programs be designed, performed and interpreted by MOE or a consultant.

The experimental programs will be designed to:

- Determine the effects of low lift pump startup on turbidity removal performance of the reactor clarifier, dual media filters and GAC contactors, and on plant treated water quality.
- Determine the sludge blanket behaviour in the reactor clarifier during plant startup.
- Determine the effects of rapid mixing on turbidity removal efficiency in the reactor clarifier, dual media filters and GAC contactors.
- Determine the turbidity removal efficiency profile in a complete dual media filter cycle, optimal backwash and rinse cycle lengths, and terminal head loss.
- Determine terminal head loss for turbidity breakthrough from the GAC contactors.

In addition, an MOE study was recommended to obtain additional knowledge about dioxins and furans so that the results can be used to establish the sources and health implications of dioxin/furan compounds on the GAC media.

F.2 EQUIPMENT OR PROCESS MODIFICATIONS OR EXPENDITURES

In order to provide optimal water treatment at the Deseronto WTP, a more intensive process monitoring program was recommended. The following equipment is therefore required:

- Online turbidimeters - with recorders at the clarifier effluent stream, each dual media filter effluent stream and each GAC contactor effluent stream. In addition, the clarifier meter should be alarmed at a high level.
- A pressure gauge on both GAC beds to measure differential pressure across the bed and a high pressure alarm light on the pressure gauge.
- A low-level alarm on the existing online free chlorine analyzer.
- A new chemical application point on the treated water distribution main for soda ash, upstream of the treated water sampling point and online pH meter.

Other recommended plant modifications include:

- Configuration of the lime/soda ash feed pumps to operate only with high lift pump operation.
- Removal of the existing mercury manometers on the flow meters.

Modifications to the existing plant that should be considered if start-stop operation is found to negatively effect turbidity removal by one or more of the unit processes include:

- Throttling of low lift pumps
- Increasing the operating volume of the treated water clearwells by lowering the water level at which low lift pumps begin operating
- Implementing a variable speed, continuous flow system, which also includes flow pacing chemical feed systems
- Implementing an initial dual media filter to waste period at plant startup

Also, if the high flows to one dual media filter while the other is backwashing is found in the experimental program to degrade treated water quality, the following should be considered:

- Detailed engineering design and analysis for changes in the filter piping configuration to eliminate this effect.

F.3 OPERATIONAL CHANGES

The following plant operational procedures, above and beyond those presently practised, were recommended:

- Jar testing to optimize chemical dosages for coagulation and flocculation, should be carried out quarterly.
- Dual media and GAC media core samples should be inspected annually for mudballs, etc. to ensure backwashing is sufficient.
- GAC contactors should be operated for optimal turbidity removal, and backwashing should take place prior to terminal head loss.
- Quarterly threshold odour numbers for treated water should be measured by a panel of 3 or more, away from the WTP site.
- Staggering of GAC media replacement is recommended.
- The pH control process should be operated to achieve a target zero or positive Langlier Index in treated water. Process control should involve measurement of calcium and alkalinity in weekly grab samples.

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Appendix I

PHYSICAL AND CHEMICAL WATER QUALITY AND PARTICULATE REMOVAL DATA FOR DESERONTO WATER TREATMENT PLANT

Table I-1
SUMMARY OF PARTICULATE REMOVAL AND pH ADJUSTMENT DATA FOR DESERONTO WTP

Month	Parameter		1987 Max.	1987 Min.	1987 Avg.	1986 Max.	1986 Min.	1986 Avg.	1985 Max.	1985 Min.	1985 Avg.
Jan	Turbidity (FTU)	R	1.7	1.0	1.40	3.8	1.20	2.1	7.20	1.40	3.90
		T	.67	.2	.29	0.9	0.2	0.5	.40	.10	.25
	Colour (TCU)	R	20	10	15			15	40	10	28.18
		T	3	3	3			5	<5	<5	<5
	Prime Coagulant (mg/L) Alum		*	*	40	*	*	40	*	*	40
	Coagulant Aid (mg/L) Aquafloc		*	*	0.08	*	*	0.08	*	*	0.08
	pH Adjustment										
	(1) Lime (mg/L)										-
	(2) Soda Ash (mg/L)								*	*	5.2
	Metal Res. Al/Fe (mg/L)	R									
		T									
	pH	R	7.95	7.85	7.92	7.55	7.35	7.45	7.90	7.50	7.69
		T	7.50	7.35	7.42	7.40	7.30	7.35	7.60	7.40	7.50
	Temperature (°C)	R	3	3	3	2	2	2	2	2	2
Feb	Turbidity (FTU)	R	1.4	1.0	1.1	6.5	0.70	3.2	3.90	.90	2.05
		T	.4	.1	.2	1.9	0.20	.2	.70	.10	.39
	Colour (TCU)	R			20	15	10	15	15	2	8.17
		T			3	<5	<5	<5	<5	<5	<5
	Prime Coagulant (mg/L) Alum		*	*	40	*	*	40	*	*	40
	Coagulant Aid (mg/L) Aquafloc		*	*	1	*	*	0.08	*	*	0.08
	pH Adjustment										
	(1) Lime (mg/L)		*	*	.55				*	*	1
	(2) Soda Ash (mg/L)		*	*	.55				*	*	-
	Metal Res. Al/Fe (mg/L)	R									
		T									
	pH	R	8.00	7.85	7.95	7.85	7.40	7.5	7.65	7.45	7.57
		T	7.4	7.4	7.4	7.60	7.30	7.4	7.60	7.35	7.47
	Temperature (°C)	R	3	3	3	2	2	2	3	2	2.37

Note: Where data is not available - no data is printed
* Chemical dosages based on chemical feed rate, constant, i.e. max = min = avg dosage
- Chemical not used

Table I-1
(Continued)

Month	Parameter		1987 Max.	1987 Min.	1987 Avg.	1986 Max.	1986 Min.	1986 Avg.	1985 Max.	1985 Min.	1985 Avg.
Mar	Turbidity (FTU)	R	3.8	2.6	3.2	4.7	0.7		10.6	1.70	4.72
		T	.5	.1	.22	1.5	0.3	.56	4.6	.30	1.00
	Colour (TCU)	R				10	5	9	>70	10	30
		T	4	2	2.9	<5	<5	<5	<5	<5	<5
	Prime Coagulant (mg/L) Alum		*	*	40	*	*	40	*	*	40
	Coagulant Aid (mg/L) Aquafloc		*	*	0.08	*	*	0.08	*	*	0.08
	pH Adjustmnet										
	(1) Lime (mg/L)		*	*	.5						-
	(2) Soda Ash (mg/L)		*	*	.5				*	*	2.32
	Metal Res. Al/Fe (mg/L)	R									
		T									
	pH	R	7.95	7.85	7.95	8.05	7.65	7.80	7.75	7.45	7.57
		T	7.45	7.35	7.40	7.70	7.55	7.6	7.60	7.00	7.39
	Temperature (°C)	R	5	3	3	5	2	4	6	2	2.48
Apr	Turbidity (FTU)	R	1.5	1.0	1.2	4.5	1.8	2.6	8.6	2.70	5.30
		T	.4	.1	.19	.9	0.1	.5	.60	.20	.32
	Colour (TCU)	R			26	10	<5	8	>70	15	46
		T			3	<5	<5	<5	5	3	4
	Prime Coagulant (mg/L) Alum		*	*	40	*	*	40	*	*	40
	Coagulant Aid (mg/L) Aquafloc		*	*	0.08	*	*	0.08	*	*	0.08
	pH Adjustment										
	(1) Lime (mg/L)		*	*	.5						-
	(2) Soda Ash (mg/L)		*	*	.5				*	*	3.25
	Metal Res. Al/Fe (mg/L)	R									
		T									
	pH	R	8.06	7.95	7.97	8.05	7.7	7.85	7.85	7.15	7.70
		T	7.45	7.30	7.40	7.70	7.55	7.6	7.55	7.35	7.45
	Temperature (°C)	R	6	6	6	12	11	11	13	4	8

Note: Where data is not available - no data is printed
* Chemical dosages based on chemical feed rate, constant, i.e. max = min = avg dosage
\- Chemical not used

Table I-1
(Continued)

Month	Parameter		1987 Max.	1987 Min.	1987 Avg.	1986 Max.	1986 Min.	1986 Avg.	1985 Max.	1985 Min.	1985 Avg.
May	Turbidity (FTU)	R	3.0	1.2	1.98	3.8	1.3	2.3	11.40	2.30	4.55
		T	.7	.1	.26	1.6	0.1	0.4	.70	.10	.30
	Colour (TCU)	R				15	5	10	>70	5	21
		T	4	2	3.2	5	<5	<5	<5	2	3
	Prime Coagulant (mg/L) Alum		*	*	40	*	*	40	*	*	40
	Coagulant Aid (mg/L) Aquafloc		*	*	0.08	*	*	0.08	*	*	0.08
	pH Adjustment										
	(1) Lime (mg/L)		*	*	.5						-
	(2) Soda Ash (mg/L)		*	*	.5				*	*	2.77
	Metal Res. Al/Fe (mg/L)	R									
		T									
	pH	R	8.35	7.65	7.9	7.95	7.0	7.8	8.05	7.55	7.84
		T	7.65	7.30	7.39	7.7	6.55	7.3	7.70	7.45	7.55
	Temperature (°C)	R	18	12	16	19	13	15	18	13	15.50
Jun	Turbidity (FTU)	R	2.8	1.1	1.72	7.6	1.7	4.3	8.60	2.50	4.28
		T	.8	.1	.29	0.5	0.1	.15	.80	.10	.25
	Colour (TCU)	R				10	5	10	>70	15	34
		T				5	<5	<5	4	2	2.75
	Prime Coagulant (mg/L) Alum		*	*	40	*	*	40	*	*	40
	Coagulant Aid (mg/L) Aquafloc		*	*	0.08	*	*	0.08	*	*	0.08
	pH Adjustment										
	(1) Lime (mg/L)		*	*	.5						-
	(2) Soda Ash (mg/L)		*	*	.5						2.834
	Metal Res. Al/Fe (mg/L)	R									
		T									
	pH	R	8.2	7.65	7.96	7.5	6.95	7.2	7.95	7.55	7.79
		T	7.65	7.25	7.32	7.25	5.10	7.1	7.70	7.45	7.57
	Temperature (°C)	R	22	14	20.5	19	18	19	20	14	17.65

Note: Where data is not available - no data is printed
* Chemical dosages based on chemical feed rate, constant, i.e. max = min = avg dosage
- Chemical not used

Table I-1
(Continued)

Month	Parameter		1987 Max.	1987 Min.	1987 Avg.	1986 Max.	1986 Min.	1986 Avg.	1985 Max.	1985 Min.	1985 Avg.
Jul	Turbidity (FTU)	R	5.8	1.7	3.64	10.9	2.0	3.74	13.6	3.9	9.08
		T	.9	.1	.40	.5	.1	.15	.8	.1	.44
	Colour (TCU)	R	17	2	9.5	10	10	10	>70	15	49.3
		T			2	4	2	3	4	2	2.7
	Prime Coagulant (mg/L) Alum		*	*	40	*	*	40	*	*	40
	Coagulant Aid (mg/L) Aquafloc		.1140	.068	.099	*	*	0.08	*	*	
	pH Adjustment										
	(1) Lime (mg/L)		*	*	.5	*	*	0.8			0.08
	(2) Soda Ash (mg/L)		*	*	.5	*	*	0.8	*	*	2.049
	Metal Res. Al/Fe (mg/L)	R									
		T									
	pH	R	8.50	7.65	8.20	7.4	6.95	7.13	8.40	7.70	8.06
		T	7.65	7.10	7.36	7.2	6.85	6.98	7.90	7.45	7.8
	Temperature (°C)	R	27	20	23.3	24	16	20.6	26	20	21.5
Aug	Turbidity (FTU)	R	8.6	4.9	5.78	11.8	1.1	6.02	14.3	3.1	6.5
		T	1.8	0.2	0.74	0.7	.1	.28	.5	.2	.32
	Colour (TCU)	R				70	10	26	>70	15	43.3
		T				4	2	3.07	5	3	3.1
	Prime Coagulant (mg/L) Alum		*	*	40	*	*	40	*	*	40
	Coagulant Aid (mg/L) Aquafloc		.099	.094	.099	*	*	0.08	*	*	0.08
	pH Adjustment										
	(1) Lime (mg/L)		*	*	.5	*	*	1.01			-
	(2) Soda Ash (mg/L)		*	*	.5	*		.95	*	*	2.1
	Metal Res. Al/Fe (mg/L)	R									
		T									
	pH	R	8.25	7.45	7.99	7.55	7.05	7.74	8.25	7.75	7.62
		T	7.70	7.25	7.37	7.25	6.70	7.01	7.95	7.5	7.80
	Temperature (°C)	R	24	19	22.16	23	16	22.9	24	20	22

Note: Where data is not available - no data is printed
* Chemical dosages based on chemical feed rate, constant, i.e. max = min = avg dosage
- Chemical not used

Table I-1
(Continued)

Month	Parameter		1987 Max.	1987 Min.	1987 Avg.	1986 Max.	1986 Min.	1986 Avg.	1985 Max.	1985 Min.	1985 Avg.
Sep	Turbidity (FTU)	R	5.2	1.3	2.89	7.2	2.8	4.65	12.40	3.50	5.43
		T	.5	.2	.337	.5	.2	.25	.70	.20	.304
	Colour (TCU)	R						12	75	15	55
		T						2	5	3	4.15
	Prime Coagulant (mg/L) Alum		*	*	40	*	*	40	*	*	40
	Coagulant Aid (mg/L) Aquafloc		*	*	.099	*	*	0.08	*	*	.08
	pH Adjustment										
	(1) Lime (mg/L)		*	*	.5	*	*	1.2			
	(2) Soda Ash (mg/L)		*	*	.5	*	*	.95			
	Metal Res. Al/Fe (mg/L)	R									
		T									
	pH	R	7.90	7.40	7.58	8.15	7.45	7.8	8.45	7.80	8.185
		T	7.6	7.2	7.35	7.3	6.85	7.05	7.95	7.15	7.58
	Temperature (°C)	R	20	18	19	20	16	18.3	21	18	19.2
Oct	Turbidity (FTU)	R	5.6	2.5	4.257	17	1.6	6.2	5.6	3.1	4.11
		T	.6	.2	.367	.6	.1	.31	.50	.18	.285
	Colour (TCU)	R			42	20	15	17.5	35	11	23.4
		T			4			<5	4	2	3.36
	Prime Coagulant (mg/L) Alum		*	*	40	*	*	40	*	*	40
	Coagulant Aid (mg/L) Aquafloc		*	*	.099	*	*	0.08	*	*	.08
	pH Adjustment										
	(1) Lime (mg/L)		*	*	.5	*	*	.4			
	(2) Soda Ash (mg/L)		*	*	.5	*	*	.4			
	Metal Res. Al/Fe (mg/L)	R									
		T									
	pH	R	7.5	8.5	7.821	8.05	7.60	7.82	8.15	7.65	7.44
		T	7.9	7.35	7.488	7.25	7.15	7.20	7.80	7.55	7.69
	Temperature (°C)	R	18	12	14.3	17	12	14	18	11	13.8

Note: Where data is not available - no data is printed
* Chemical dosages based on chemical feed rate, constant, i.e. max = min = avg dosage
- Chemical not used

Table I-1
(Continued)

Month	Parameter		1987 Max.	1987 Min.	1987 Avg.	1986 Max.	1986 Min.	1986 Avg.	1985 Max.	1985 Min.	1985 Avg.
Nov	Turbidity (FTU)	R	3.6	3.6	3.6	4	1.5	2.3	5.6	2.8	3.8
		T	.5	.2	0.332	.5	.1	.22	.3	.10	.184
	Colour (TCU)	R				20	15	18.75	31	30	30
		T				<5	<5	<5	<5	<5	<5
	Prime Coagulant (mg/L) Alum		*	*	40	*	*	40	*	*	40
	Coagulant Aid (mg/L) Aquafloc		.101	.099	.099	*	*	0.08	*	*	.08
	pH Adjustment										
	(1) Lime (mg/L)		*	*	.5	*	*	.48			
	(2) Soda Ash (mg/L)		*	*	.5	*	*	.48			
	Metal Res. Al/Fe (mg/L)	R									
		T									
	pH	R	8.05	8.05	8.05	8.25	7.80	8.07	8.0	7.70	7.85
		T	7.60	7.45	7.54	7.40	7.30	7.33	7.85	7.65	7.77
	Temperature (°C)	R	-	-	-	11	5	7	11	4	7.3
Dec	Turbidity (FTU)	R	3.1	1.2	2.013	3.5	1.3	2.32	13.8	3.0	6.61
		T	.6	.1	.267	.5	.2	.33	.6	.22	.317
	Colour (TCU)	R					12	40	20	28	
		T					4	4	3	3.5	
	Prime Coagulant (mg/L) Alum		*	*	40	*	*	40	*	*	40
	Coagulant Aid (mg/L) Aquafloc		*	*	.099	*	*	0.08	*	*	.08
	pH Adjustment										
	(1) Lime (mg/L)		*	*	0.5	*	*	.95			
	(2) Soda Ash (mg/L)		*	*	0.5	*	*	.95			
	Metal Res. Al/Fe (mg/L)	R									
		T									
	pH	R	8.00	7.70	7.834	8.25	8.00	8.12	7.85	7.50	7.68
		T	7.65	7.45	7.581	7.45	7.35	7.41	7.80	7.40	7.58
	Temperature (°C)	R	5	3	44	5	3	3.4	4	2	2.5

Note: Where data is not available - no data is printed
* Chemical dosages based on chemical feed rate, constant, i.e. max = min = avg dosage
- Chemical not used

Table I-2

PARTICULATE REMOVAL PROFILE FOR DESERONTO WTP

Date	Turbidity (FTU)				Colour (TCU)		Alum Coagulant	Aquafloc Coag. Aid	Metal Res. Al/Fe (mg/L)		pH		Raw Temp.
	Raw	Set.	Filter	Treat.	Raw	Treat.	mg/L	mg/L	Raw	Treat	Raw	Treat.	°C
Jan/87													
1							40	0.08					
2							40	0.08					
3							40	0.08					
4							40	0.08					
5				.3			40	0.08				7.35	
6				.3			40	0.08				7.45	
7	1.7			.3	15		40	0.08			7.95	7.50	3
8							40	0.08			7.85	7.45	
9				.67			40	0.08				7.40	3
10							40	0.08					
11							40	0.08					
12				.2			40	0.08				7.40	
13				.2			40	0.08				7.40	
14				.3			40	0.08				7.40	
15	1.0			.4	20		40	0.08			7.95	7.45	3
16							40	0.08					
17							40	0.08					
18							40	0.08					
19	1.6			.2	10		40	0.08			7.40		3
20	1.7			.2	15		40	0.08			7.40		3
21				.3			40	0.08					
22				.4			40	0.08					
23				.3			40	0.08			7.40		
24							40	0.08					
25							40	0.08					
26				.2			40	0.08			7.40		
27				.2			40	0.08			7.45		
28				.2			40	0.08			7.40		
29	1.0			.2	15		40	0.08			7.40		3
30							40	0.08					
31							40	0.08					

Note: Where no data is printed, data is not available

(23810/268)

Table I-2
Continued

Date	Turbidity (FTU)				Colour (TCU)		Alum Coagulant	Aquafloc Coag. Aid	Metal Res. Al/Fe (mg/L)		pH		Raw Temp.
	Raw	Set.	Filter	Treat.	Raw	Treat.	mg/L	mg/L	Raw	Treat	Raw	Treat.	°C
Mar/87													
1							40	0.08				7.40	
2				.1		2	40	0.08			8.0	7.40	3
3	2.6			.2		3	40	0.08			8.0	7.40	3
4				.3		3	40	0.08			8.0	7.40	3
5							40	0.08			8.0	7.40	3
6							40	0.08			8.0	7.40	3
7							40	0.08			8.0	7.40	3
8							40	0.08					
9				.1		2	40	0.00			8.0	7.40	3
10				.4		3	40	0.08			8.0	7.40	3
11	3.8			.2		4	40	0.08			8.0	7.40	3
12				.2		3	40	0.08			8.0	7.40	3
13				.2		2	40	0.08			8.0	7.40	3
14							40	0.08					
15							40	0.08					
16				.2		4	40	0.08			8.0	7.40	3
17				.2		3	40	0.08			8.0	7.40	3
18	2.9			.2		2	40	0.08			8.0	7.40	3
19				.2		3	40	0.08			8.0	7.40	3
20				.5		3	40	0.08			8.0	7.40	4
21							40	0.08					
22							40	0.08					
23				.2		2	40	0.08			8.0	7.40	4
24				.2		3	40	0.08			8.0	7.40	5
25	3.5			.2		3	40	0.08			8.0	7.40	5
26				.2		4	40	0.08			8.0	7.40	5
27				.2		3	40	0.08			8.0	7.40	5
28							40	0.08			8.0	7.40	5
29							40	0.08					
30				.2		3	40	0.08					
31				.2		3	40	0.08					

Note: Where no data is printed, data is not available

Table I-2
Continued

Date	Turbidity (FTU)				Colour (TCU)		Alum Coagulant	Aquafloc Coag. Aid	Metal Res. Al/Fe (mg/L)		pH		Raw Temp
	Raw	Set.	Filter	Treat.	Raw	Treat.	mg/L	mg/L	Raw	Treat	Raw	Treat.	°C
Jul/87													
1							40	.068					
2	2.9			.2			40	.095			7.5		20
3	2.1			.2			40	.099			7.8		
4							40	.099					20
5							40	.098					
6	1.7			.5			40	-			8.1		20
7	2.8			.8			40	.103			8.4		22
8	3.2			.8			40	.099			8.4		22
9	2.8			.4			40	.099			8.5		23
10	3.2			.2			40	.099			8.3		23
11							40	.099					
12							40	.099					
13	3.7			.8			40	.099			8.4		25
14	3.9			.9	2	2	40	.099			8.4		27
15	2.6			.2			40	.099			7.9		23
16	3.8			.1			40	.099			8.2		22
17				.5			40	.099					
18							40	.099					
19							40	.099					
20	5.5			.3	17		40	.099			8.0		24
21	4.2			.3			40	.099			8.4		24
22	4.5			.3			40	-			8.5		25
23	5.4			.2			40	.100			8.3		25
24	4.4			.7			40	.099			8.4		25
25							40	.099					
26							40	.099					
27	2.8			.3			40	.099			7.7		25
28	5.1			.1			40	.099			8.0		24
29	4.1			.2			40	.098			8.3		23
30	5.8			.3			40	.098			8.5		24
31	5.8			.4			40	.099			8.1		24

Note: Where no data is printed, data is not available

Table I-2
Continued

Date	Turbidity (FTU)				Colour (TCU)		Alum Coagulant mg/L	Aquafloc Coag. Aid mg/L	Metal Res. Al/Fe (mg/L)		pH		Raw Temp. °C
	Raw	Set.	Filter	Treat.	Raw	Treat.			Raw	Treat	Raw	Treat.	
Oct/87													
1				.5			40	.099					
2	2.5			.4			40	.099				7.5	
3							40	.099			7.0	7.5	18
4							40	.099					
5	4.9			.4			40	.099					
6	4.6			.53	42	4	40	.099			2.6	7.4	15
7	2.9			.4			40	.099			8.5	7.9	
8				.9			40	.099			7.5	7.5	
9				.4			40	.099				7.5	
10							40	.099				7.5	
11							40	.099					
12	4.2			.4			40	.099					
13				.3			40	.099			7.9	7.5	12
14							40	.099				7.5	
15				.3			40	.099				7.5	
16				.3			40	.099				7.5	
17							40	.099				7.5	
18							40	.099					
19	5.1			.3			40	.099					
20				.3			40	.099			7.9	7.5	13
21	5.6			.4			40	.099				7.5	
22				.3			40	.099			7.8	7.5	13
23				.2			40	.099				7.5	
24							40	.099				7.5	
25							40	.099					
26				.2			40	.099					
27				.6			40	.099				7.5	
28				.2			40	.099				7.5	
29				.3			40	.099				7.5	
30				.5			40	.099				7.5	
31							40	.099				7.5	

Note: Where no data is printed, data is not available

(23810/268)

Table I-2
Continued

Date	Turbidity (FTU)				Colour (TCU		Alum Coagulant mg/L	Aquafloc Coag. Aid mg/L	Metal Res. Al/Fe (mg/L)		pH		Raw Temp. °C
	Raw	Set.	Filter	Treat.	Raw	Treat.			Raw	Treat	Raw	Treat.	
Jan/86													
1													
2							40	0.08					
3							40	0.08					
4							40	0.08					
5							40	0.08					
6							40	0.08					
7							40	0.08					
8							40	0.08					
9							40	0.08					
10							40	0.08					
11							40	0.08					
12							40	0.08					
13	2.7			0.2			40	0.08					
14	2.8			0.2			40	0.08					
15	2.4			0.2			40	0.08					
16	3.8			0.4			40	0.08					
17	1.7			0.2			40	0.08					
18							40	0.08					
19							40	0.08					
20	1.2			0.5			40	0.08					
21	1.5			0.5			40	0.08					
22	4.0			0.5			40	0.08					
23	3.0			0.5			40	0.08					
24	2.6						40	0.08					
25							40	0.08					
26							40	0.08					
27	2.1						40	0.08					
28	3.3			0.6			40	0.08					
29	2.3			0.9			40	0.08					
30	2.8			0.8			40	0.08					
31	2.4			0.3			40	0.08					
							40	0.08					

Note: Where no data is printed, data is not available

Table I-2
Continued

Date	Turbidity (FTU)				Colour (TCU)		Alum Coagulant	Aquafloc Coag. Aid	Metal Res. Al/Fe (mg/L)		pH		Raw Temp.
	Raw	Set.	Filter	Treat.	Raw	Treat.	mg/L	mg/L	Raw	Treat	Raw	Treat.	°C
Mar/86													
1							40	0.08					
2							40	0.08					
3	4.1			0.5			40	0.08					
4	1.0			0.6	15	<5	40	0.08					
5	0.8			0.6	10	<5	40	0.08					
6	0.8			0.5	10	<5	40	0.08					
7	0.8			0.8	10	<5	40	0.08					
8						<5	40	0.08					
9							40	0.08					
10	0.7			0.5	10		40	0.08					
11	0.7			0.9	5	<5	40	0.08					
12	1.1			0.8	10	<5	40	0.08					
13	0.8			1.5	10	<5	40	0.08					
14	1.0			0.3	10	<5	40	0.08					
15							40	0.08					
16							40	0.08					
17	1.1			0.6	5	<5	40	0.08					
18	1.3			0.4	5	<5	40	0.08					
19	1.2			0.7	5	<5	40	0.08					
20	1.5			0.6	5	<5	40	0.08					
21	2.9			0.5	10	<5	40	0.08					
22							40	0.08					
23							40	0.08					
24	3.2			0.6	10	<5	40	0.08					
25	4.0			0.6	10	<5	40	0.08					
26	4.7			0.8	10	<5	40	0.08					
27	4.0			0.5	10	<5	40	0.08					
28							40	0.08					
29							40	0.08					
30							40	0.08					
31							40	0.08					

Note: Where no data is printed, data is not available

(23810/268)

Table I-2
Continued

Date	Turbidity (FTU)				Colour (TCU)		Alum Coagulant	Aquafloc Coag. Aid	Metal Res. Al/Fe (mg/L)		pH		Raw Temp.
	Raw	Set.	Filter	Treat.	Raw	Treat.	mg/L	mg/L	Raw	Treat	Raw	Treat.	°C
Jul/86													
1							40	0.08					
2	2.9			.20	10	4	40	0.08			7.1		20
3	2.3			.10	10	3	40	0.08			7.25		19
4	2.5			.10	10	4	40	0.08			7.30		16
5							40	0.08					
6							40	0.08					
7	3.0			.10	10	2	40	0.08			7.1		20
8	3.2			.20	10	3	40	0.08			7.15		21
9	3.2			.10	10	4	40	0.08			7.0		22
10	2.1			.10	10	2	40	0.08			7.25		24
11	2.0			.50	10	3	40	0.08			7.05		20
12							40	0.08					
13							40	0.08					
14	5.0			.10	10	4	40	0.08			7.0		18
15	4.8			.10	10	2	40	0.08			7.05		19
16				.10	10	3	40	0.08			6.95		20
17	3.4			.10	10	4	40	0.08			7.10		20
18	3.3			.10	10	2	40	0.08			7.15		21
19							40	0.08					
20							40	0.08					
21	2.3			.10	10	3	40	0.08			7.0		19
22	4.8			.10	10	4	40	0.08			7.15		20
23	2.0			.10	10	2	40	0.08			7.15		22
24	4.4			.20	10	3	40	0.08			7.40		24
25	4.8			.40		4	40	0.08					24
26							40	0.08					
27							40	0.08					
28	2.5			.10	10	2	40	0.08			6.95		21
29	4.1			.10	10	3	40	0.08			7.35		24
30							40	0.08					
31	5.0			.10	10	3	40	0.08			7.05		19

Note: Where no data is printed, data is not available

Table I-2
Continued

Date	Turbidity (FTU)				Colour (TCU)		Alum Coagulant	Aquafloc Coag. Aid	Metal Res. Al/Fe (mg/L)		pH		Raw Temp.
	Raw	Set.	Filter	Treat.	Raw	Treat.	mg/L	mg/L	Raw	Treat	Raw	Treat.	°C
Oct/86													
1	3.6			.2			40	0.08			7.8	7.15	17
2	4.0			.2			40	0.08			7.8	7.15	17
3	3.7			.2		<5	40	0.08			7.8	7.15	16
4	4.0			.2			40	0.08			7.8	7.15	16
5	4.0			.1			40	0.08			7.8	7.15	16
6	6.7			.1		<5	40	0.08			7.45	7.15	16
7	9.1			.1	20		40	0.08			7.60	7.15	15
8	16.0			.2			40	0.08			7.75	7.15	14
9	13.2			.1			40	0.08			7.75	7.25	14
10							40	0.08					
11							40	0.08					
12							40	0.08					
13							40	0.08				7.2	13
14	4.7			.5			40	0.08			7.6	7.2	13
15	6.5			.4	15		40	0.08				7.25	
16	2.9			.4		<5	40	0.08			8.0	7.20	12
17				.6			40	0.08				7.20	
18				.5			40	0.08				7.20	
19				.5			40	0.08				7.20	
20	17.0			.2			40	0.08			8.0	7.25	12
21	7.9			.5		<5	40	0.08			7.95	7.25	12
22	7.3			.4	20		40	0.08			7.75	7.20	12
23	3.3			.5			40	0.08			8.0	7.20	12
24				.5			40	0.08				7.20	
25							40	0.08					
26	2.7						40	0.08					
27	1.6			.4			40	0.08			8.05	7.20	12
28	2.2			.2			40	0.08			7.85	7.20	12
29	3.5			.2	15		40	0.08			7.90	7.25	12
30				.2			40	0.08			7.95	7.25	12
31							40	0.08					

Note: Where no data is printed, data is not available

Table I-2
Continued

Date	Turbidity (FTU)				Colour (TCU)		Alum Coagulant	Aquafloc Coag. Aid	Metal Res. Al/Fe (mg/L)		pH		Raw Temp.
	Raw	Set.	Filter	Treat.	Raw	Treat.	mg/L	mg/L	Raw	Treat	Raw	Treat.	°C
Jan/85													
1							40	0.08					
2	4.1			.2	40	<5	40	0.08			7.75	7.55	2
3	4.6			.3	20	<5	40	0.08			7.65	7.55	2
4	6.5			.2	30	<5	40	0.08			7.50	7.45	2
5							40	0.08					
6							40	0.08					
7	4.8			.2	30	<5	40	0.08			7.75	7.6	2
8	4.8			.2	30	<5	40	0.08			7.75	7.6	2
9	2.2			.2	30	<5	40	0.08			7.80	7.6	2
10	3.4			.3	30	<5	40	0.08			7.65	7.5	2
11	2.3			.3	30	<5	40	0.08			7.70	7.5	2
12							40	0.08					
13							40	0.08					
14	4.5			.3	30	<5	40	0.08			7.75	7.6	2
15	5.3			.2	30	<5	40	0.08			7.65	7.6	2
16	1.90			.2	30	<5	40	0.08			7.75	7.45	2
17	7.0			.1	40	<5	40	0.08			7.75	7.45	2
18	1.7			.2	20	<5	40	0.08			7.90	7.50	2
19							40	0.08					
20							40	0.08					
21	7.20			.4	40	<5	40	0.08			7.75	7.5	2
22	4.3			.1	30	<5	40	0.08			7.65	7.5	2
23	4.1			.4	30	<5	40	0.08			7.65	7.5	2
24	1.7			.2	30	<5	40	0.08			7.70	7.45	2
25	2.4			.2	30	<5	40	0.08			7.55	7.4	2
26							40	0.08					
27							40	0.08					
28	2.4			.4	15	<5	40	0.08			7.65	7.5	2
29	3.2			.3	30	<5	40	0.08			7.65	7.45	2
30	3.0			.3	15	<5	40	0.08			7.65	7.45	2
31	1.4			.3	10	<5	40	0.08			7.65	7.45	2

Note: Where no data is printed, data is not available

Table I-2
Continued

Date	Turbidity (FTU)				Colour (TCU)		Alum Coagulant	Aquafloc Coag. Aid	Metal Res. Al/Fe (mg/L)		pH		Raw Temp.
	Raw	Set.	Filter	Treat.	Raw	Treat.	mg/L	mg/L	Raw	Treat	Raw	Treat.	°C
Mar/85													
1	2.8			.40	10		40	0.08			7.6	7.40	3
2							40	0.08					
3							40	0.08					
4	2.8			.5	10		40	0.08			7.55	7.45	2
5	3.0			.5	10		40	0.08			7.60	7.40	2
6	2.3			.5	10		40	0.08			7.65	7.40	2
7	5.1			2.4	10		40	0.08			7.45	7.40	2
8	5.4			1.2	30		40	0.08			7.45	7.35	2
9							40	0.08					
10							40	0.08					
11	3.3			1.4	10		40	0.08			7.60	7.45	2
12	1.7			1.3	10		40	0.08			7.50	7.35	2
13	3.4			1.2	30		40	0.08			7.55	7.40	2
14	10.6			4.6	>70		40	0.08			7.60	7.45	2
15	9.10			1.3	>70		40	0.08			7.60	7.30	2
16							40	0.08					
17							40	0.08					
18	8.5			.30	>70	<5	40	0.08			7.5	7.35	2
19	8.4			.70	>70	<5	40	0.08			7.45	7.35	2
20	6.8			.80	>70	<5	40	0.08			7.55	7.35	2
21	5.8			.70	30	<5	40	0.08			7.55	7.40	2
22	6.0			.40	30	<5	40	0.08			7.45	7.35	2
23							40	0.08					
24							40	0.08					
25	2.7			.90	20	<5	40	0.08			7.55	7.30	3
26	2.1			.60	20	<5	40	0.08			7.55	7.30	3
27	2.4			.30	20	<5	40	0.08			7.70	7.35	3
28	2.8			.60	30	<5	40	0.08			7.75	7.35	6
29	4.2			.30	30	<5	40	0.08			7.70	7.60	4
30							40	0.08					
31							40	0.08					

Note: Where no data is printed, data is not available

Table I-2
Continued

Date	Turbidity (FTU)				Colour (TCU)		Alum Coagulant mg/L	Aquafloc Coag. Aid mg/L	Metal Res. Al/Fe (mg/L)		pH		Raw Temp. °C
	Raw	Set.	Filter	Treat.	Raw	Treat.			Raw	Treat	Raw	Treat.	
Jul/85													
1							40	0.08					
2	7.9			.1	60	2	40	0.08			7.7		16
3	4.8			.2	30	2	40	0.08			7.85		20
4	3.9			.2	20	3	40	0.08					20
5	9.7			.2	>70	2	40	0.08			8.00		22
6							40	0.08					
7							40	0.08					
8	7.8			.2	60	2	40	0.08			7.95		21
9	5.6			.3	.5	3	40	0.08			7.80		22
10	6.2			.3	40	2	40	0.08			8.25		22
11	6.4			.4	50	3	40	0.08			7.85		22
12	9.8			.4	50	4	40	0.08			7.90		22
13							40	0.08					
14							40	0.08					
15	10.8			.6	>70	3	40	0.08			8.35		22
16	13.6			.6	>70	3	40	0.08			8.10		22
17	10.7			.5	30	3	40	0.08			8.15		22
18	4.6			.3	40	2	40	0.08			8.10		20
19	6.7			.2		3	40	0.08			8.05		22
20							40	0.08					
21							40	0.08					
22	12.7			.6	70	2	40	0.08			8.40		22
23	12.8			.7	>70								
24	9.8			.7	70	2	40	0.08			8.15		22
25	11.8			.8	70	2	40	0.08			8.35		22
26	11.9			.8	50	3	40	0.08			8.20		23
27							40	0.08					
28							40	0.08					
29	12.8			.4	70	4	40	0.08			8.20		23
30	11.8			.6	>70	3	40	0.08			8.05		22
31	7.7			.5	50	4	40	0.08			7.90		22

Note: Where no data is printed, data is not available

Table I-2
Continued

Date	Turbidity (FTU)				Colour (TCU)		Alum Coagulant mg/L	Aquafloc Coag. Aid mg/L	Metal Res. Al/Fe (mg/L)		pH		Raw Temp. °C
	Raw	Set.	Filter	Treat.	Raw	Treat.			Raw	Treat	Raw	Treat.	
Oct/85													
1	5.3			.50	15	3	40	.08			7.8	7.75	18
2	3.2			.31	11	4	40	.08				7.75	
3						3	40	.08				7.8	
4	3.6			.19	20	4	40	.08			7.65	7.7	18
5							40	.08					
6							40	.08					
7	5.20			.18	30	4	40	.08			8.05	7.8	15
8				.25		4	40	.08				7.6	
9	3.90			.27	20	3	40	.08			8.00	7.55	15
10				.31		3	40	.08				7.55	
11							40	.08				7.60	
12							40	.08					
13							40	.08					
14							40	.08					
15	4.20			.20		4	40	.08			7.95	7.70	14
16	4.4			.20		3	40	.08			8.15	7.60	14
17	5.2			.30	15	2	40	.08			7.95	7.65	14
18	5.6			.50			40	.08			7.95	7.65	14
19							40	.08					
20							40	.08					
21	4.80			.40	30		40	.08			7.85	7.70	13
22	3.4			.20	35		40	.08			7.95	7.80	13
23	3.2			.20	35		40	.08			7.95	7.75	13
24	3.3			.50			40	.08			7.90	7.80	13
25	5.3			.30			40	.08			7.90	7.60	13
26							40	.08					
27							40	.08					
28	3.6			.20			40	.08			7.85	7.80	13
29	3.2			.20			40	.08			7.80	7.70	12
30	3.1			.30			40	.08			7.85	7.65	11
31	3.4			.20			40	.08			7.80	7.65	11

Note: Where no data is printed, data is not available

Table I-3

DRINKING WATER SURVEILLANCE PROGRAM DESERONTO WTP 1988

	WATER TREATMENT PLANT				DISTRIBUTION SYSTEM	
SITE TYPE	RAW	TREATED	CARBON 1	CARBON 2	SITE 1 STANDING	SITE 1 FREE FLOW
CHEMISTRY (FLD)						
FLD CHLORINE (COMB) (MG/L)		**DET'N LIMIT = N/A**		**GUIDELINE = N/A**		
JAN	.	.100	.	.	.200	.20
	.	.400	.	.	.300	.20
MAR	.	.400	.	.	.100	.300
APR	.	.800	.	.	.100	.20
MAY	.	.400	.	.	.100	.40
JUN	.	.	.	.	.100	.200
JUL	.	.100	.	.	.100	.400
SEP	.	.200	.	.	.100	.30
OCT	.	.400	.	.	.100	.40
NOV	.	.400	.	.	.100	.300
DEC	.	.600	.	.	.200	.20
FLD CHLORINE FREE (MG/L)		**DET'N LIMIT = N/A**		**GUIDELINE = N/A**		
JAN	.	.300	.	.	.200	.60
	.	.400	.	.	.100	.40
MAR	.	.800	.	.	.100	.700
APR	.	1.100	.	.	.100	.5
MAY	.	.800	.	.	.100	.60
JUN	.	.900	.	.	.300	.800
JUL	.	1.000	.	.	.	.60
SEP	.	.800	.	.	.100	.5
OCT	.	.600	.	.	.100	.600
NOV	.	.400	.	.	.100	.500
DEC	.	.500	.	.	.200	.80
FLD CHLORINE (TOTAL) (MG/L)		**DET'N LIMIT = N/A**		**GUIDELINE = N/A**		
JAN	.	.400	.	.	.400	.8
	.	.800	.	.	.400	.600
MAR	.	1.200	.	.	.200	1.00
APR	.	1.900	.	.	.200	.7
MAY	.	1.200	.	.	.200	1.000
JUN	.	.900	.	.	.400	1.000
JUL	.	1.100	.	.	.100	1.0
SEP	.	1.000	.	.	.200	.8
OCT	.	1.000	.	.	.200	1.000
NOV	.	.800	.	.	.200	.8
DEC	.	1.100	.	.	.400	1.0

Note: Refer to end of table for key to codes and abbreviations

Table I-3

DRINKING WATER SURVEILLANCE PROGRAM DESERONTO WTP 1988

	WATER TREATMENT PLANT				DISTRIBUTION SYSTEM	
SITE TYPE	RAW	TREATED	CARBON 1	CARBON 2	SITE 1 STANDING	SITE 1 FREE FLOW
FLD PH (DIMENSIONLESS)		**DET'N LIMIT = N/A**		**GUIDELINE = 6.5-8.5(A4)**		
JAN	7.800	7.600	.	.	7.400	7.200
	7.600	7.100	7.700	7.700	7.400	7.200
	7.700	7.300	.	7.300	.	.
MAR	7.700	7.550	.	.	7.200	7.400
APR	7.500	6.900	8.400	.	7.200	7.000
MAY	7.800	7.200	.	.	7.400	7.400
JUN	8.200	7.300	.	.	7.200	7.400
JUL	8.300	7.050	7.200	7.300	7.400	7.500
AUG	7.900	7.100	7.400	7.380	7.400	7.200
SEP	8.650	7.740	7.900	7.940	7.300	7.200
OCT	8.100	7.040	7.070	7.230	7.400	7.200
NOV	7.940	6.950	6.940	6.980	7.500	7.200
DEC	7.670	6.640	6.750	6.820	7.100	7.000
FLD TEMPERATURE (DEG.C)		**DET'N LIMIT = N/A**		**GUIDELINE = 15 (A1)**		
JAN	3.000	5.000	.	.	19.000	5.000
	1.000	2.000	2.000	2.000	18.000	4.000
	1.000	2.000	.	2.000	.	.
MAR	4.000	4.000	.	.	18.000	4.000
APR	6.500	6.500	6.500	.	18.000	7.000
MAY	10.000	10.000	.	.	16.000	10.000
JUN	17.000	17.000	17.000	17.000	20.000	18.000
JUL	18.000	18.000	18.000	18.000	20.000	20.000
AUG	26.000	26.000	27.000	27.000	25.000	25.000
SEP	19.000	20.000	20.000	20.000	18.000	20.000
OCT	16.000	16.000	17.000	17.000	17.000	18.000
NOV	8.000	8.000	8.000	8.000	19.000	10.000
DEC	3.000	4.000	4.000	4.000	18.000	7.000
FLD TURBIDITY (FTU)		**DET'N LIMIT = N/A**		**GUIDELINE = 1.0 (A1)**		
JAN	.900	.200	.	.	.	.
	1.200	.400	.300	.300	.	.
	.900	.300	.	.300	.	.
MAR	1.000	.600	.	.	.	.
APR	3.000	2.800	.480	.	2.300	1.100
MAY	2.500	.500	.	.	.	.
JUN	2.200	.200	.	.	.	.
JUL	3.600	.300	.400	.500	.	.
AUG	5.600	.500	2.400	2.300	.	.
SEP	6.900	.700	.400	.300	.	.
OCT	5.000	.300	.500	.500	.	.
NOV	3.700	.300	.400	.500	.	.
DEC	4.000	.200	.200	.200	.	.

Table I-3

DRINKING WATER SURVEILLANCE PROGRAM DESERONTO WTP 1988

	WATER TREATMENT PLANT				DISTRIBUTION SYSTEM	
SITE	RAW	TREATED	CARBON 1	CARBON 2	SITE 1	
TYPE					STANDING	FREE FLOW
COLOUR (TCU)		**DET'N LIMIT = .5**		**GUIDELINE = 5.0 (A3)**		
JAN	18.000	5.000	.	.	5.500	4.500
	18.500	5.000	8.000	8.000	7.000	5.500
	19.500	6.500	.	6.500	.	.
MAR	20.000	3.500	.	.	6.500	4.000
APR	23.500	5.500	1.500 <T	.	11.000	5.500
MAY	!!S	3.500	.	.	10.000	3.000
JUN	14.000	1.500	3.500	3.000	2.500	1.000
JUL	12.000	.500 <T	1.000 <T	1.000 <T	5.500	.500
AUG	12.000	2.500	3.500	2.000 <T	6.500	3.000
SEP	12.000	.500 <T	2.000 <T	1.500 <T	6.500 RRV	.500 <T
OCT	13.000	1.500 <T	3.500	3.000	7.500	1.500 <T
NOV	13.500	1.500 <T	3.500	3.000	5.500	1.500
CONDUCTIVITY (UMHO/CM)		**DET'N LIMIT = 1**		**GUIDELINE = 400 (F2)**		
JAN	283	289	.	.	290	287
	283	294	286	286	288	291
	282	288	.	288	.	.
MAR	276	284	.	.	289	285
APR	230	242	232	.	245	242
MAY	!!S	249	.	.	250	247
JUN	269	279	276	275	279	279
JUL	265	278	271	278	271	263
AUG	264	270	270	270	270	268
SEP	262	273	268	269	274	268
OCT	260	272	270	268	273	273
NOV	269	281	279	279	284	280
FLUORIDE (MG/L)		**DET'N LIMIT = .01**		**GUIDELINE = 2.400 (A1)**		
JAN	.040 <T	.040 <T	.	.	.040 <T	.040 <T
	.080	.060	.060	.060	.080	.060
	.080	.040 <T	.	.040 <T	.	.
MAR	.080	.070	.	.	.080	.070
APR	.060	.050	.060	.	.050	.050
MAY	!!S	.060	.	.	.060	.060
JUN	.080	.060	.070	.070	.060	.060
JUL	.120	.100	.070	.080	.090	.080
AUG	.100	.090	.090	.090	.080	.090
SEP	.080	.060	.060	.060	.060	.080
OCT	.100	.080	.080	.080	.080	.080
NOV	.100	.060	.080	.080	.080	.080

Table 1-3

DRINKING WATER SURVEILLANCE PROGRAM DESERONTO WTP 1988

	WATER TREATMENT PLANT				DISTRIBUTION SYSTEM	
SITE TYPE	RAW	TREATED	CARBON 1	CARBON 2	SITE 1 STANDING	SITE 1 FREE FLOW
CHEMISTRY (LAB)						
ALKALINITY (MG/L)			DET'N LIMIT = .200		GUIDELINE = 30-500 (A4)	
JAN	115.300	98.100	.	.	97.000	96.300
	114.100	98.400	99.600	99.700	98.600	98.100
	111.600	97.400	.	97.400	.	.
MAR	110.200	88.400	.	.	90.600	90.700
APR	94.000	75.600	94.800	.	76.100	75.300
MAY	!!S	79.400	.	.	79.100	78.300
JUN	106.500	87.300	88.500	88.300	87.200	87.300
JUL	109.000	87.900	93.300	96.400	88.700	88.600
AUG	103.600	93.000	92.200	91.500	87.800	90.400
SEP	98.600	78.700	80.500	80.900	79.100	78.400
OCT	104.600	84.800	87.600	86.900	85.000	85.400
NOV	106.700	86.500	88.800	89.200	87.500	86.200
CALCIUM (MG/L)			DET'N LIMIT = .100		GUIDELINE = 100 (F2)	
JAN	44.400	43.800	.	.	44.000	43.800
	46.200	45.800	45.400	45.800	47.000	46.600
	45.800	45.800	.	45.800	.	.
MAR	40.000	39.800	.	.	41.000	39.400
APR	36.800	35.400	38.000	.	37.400	38.000
MAY	!!S	36.400	.	.	36.600	36.800
JUN	40.400	40.400	40.200	40.200	39.800	40.800
JUL	41.800	42.800	42.800	42.000	42.400	41.800
AUG	39.900	39.100	39.800	40.100	38.300	39.000
SEP	39.000	39.600	39.000	39.000	38.200	38.200
OCT	41.600	42.200	42.000	41.400	42.800	42.600
NOV	40.400	40.000	40.200	41.600	39.600	39.400
CHLORIDE (MG/L)			DET'N LIMIT = .200		GUIDELINE = 250 (A3)	
JAN	9.500	10.700	.	.	11.400	11.300
	9.800	11.600	9.700	9.600	11.700	11.500
	9.300	9.300	.	9.300	.	.
MAR	11.600	14.500	.	.	14.300	14.100
APR	7.400	10.200	7.300	.	10.800	10.200
MAY	!!S	9.100	.	.	9.400	9.200
JUN	10.600	10.900	10.100	9.900	11.400	11.300
JUL	11.100	12.600	11.700	11.800	13.100	12.700
AUG	11.400	12.100	11.900	11.800	12.000	11.900
SEP	11.800	12.900	11.300	11.200	13.400	13.100
OCT	10.200	11.800	10.000	10.100	12.300	12.000
NOV	12.000	13.500	11.800	11.900	14.000	13.600

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DRINKING WATER SURVEILLANCE PROGRAM DESERONTO WTP 1988

	WATER TREATMENT PLANT				DISTRIBUTION SYSTEM	
SITE TYPE	RAW	TREATED	CARBON 1	CARBON 2	SITE 1 STANDING	SITE 1 FREE FLOW
HARDNESS (MG/L)			**DET'N LIMIT = .500**		**GUIDELINE = 80-100 (A4)**	
JAN	131.000	130.000	.	.	131.000	130.000
	136.000	134.000	133.000	134.000	137.000	137.000
	134.000	134.000	.	134.000	.	.
MAR	120.000	119.000	.	.	122.000	118.000
APR	108.000	103.000	111.000	.	109.000	110.000
MAY	!!S	105.000	.	.	107.000	107.000
JUN	121.000	120.000	120.000	120.000	119.000	122.000
JUL	124.000	127.000	130.000	125.000	126.000	125.000
AUG	119.700	117.700	119.500	119.800	115.700	117.500
SEP	118.000	119.000	117.000	118.000	116.000	116.000
OCT	124.000	126.000	125.000	123.000	127.000	127.000
NOV	122.000	121.000	121.000	124.000	120.000	119.000
IONCAL (DMSNLESS)			**DET'N LIMIT = N/A**		**GUIDELINE = N/A**	
JAN	.000 NAF	.000 NAF	.	.	.000 NAF	.000 NA
	.000 NAF	.000 NAF	.000 NAF	.000 NAF	.000 NAF	.000 NA
	.000 NAF	.000 NAF	.	.000 NAF	.	.
MAR	.000 NAF	.000 NAF	.	.	.000 NAF	.000 NA
APR	.000 NAF	.000 NAF	.000 NAF	.	.000 NAF	.000 NA
MAY	.000 NAF	.000 NAF	.	.	.000 NAF	.000 NAF
JUN	.000 NAF	.000 NAF	.000 NAF	.000 NAF	.000 NAF	.000 NA
JUL	.000 NAF	.000 NAF	.000 NAF	.000 NAF	.000 NAF	.000 NA
AUG	1.317	4.561	1.699	.663	3.935	1.765
SEP	1.679	1.291	.854	.940	1.317	.693
OCT	4.037	4.031	3.098	2.452	4.718	4.525
NOV	.439	.885	1.090	1.344	3.299	1.976
DEC	.000 NAF	.000 NAF	.000 NAF	.000 NAF	.000 NAF	.000 NAF
LANGELIERS INDEX (DMSNLESS)			**DET'N LIMIT = N/A**		**GUIDELINE = N/A**	
JAN	.527 NAF	.258 NAF	.	.	.325 NAF	.311 NAF
	.300 NAF	-.103 NAF	.202 NAF	.276 NAF	.352 NAF	.185 NA
	.486 NAF	.195 NAF	.	.195 NAF	.	.
MAR	.355 NAF	.034 NAF	.	.	.035 NAF	-.120 NAF
APR	.077 NAF	-.129 NAF	.674 NAF	.	-.073 NAF	-.320 NA
MAY	.	.102 NAF	.	.	.152 NAF	.131 NA
JUN	.577 NAF	.377 NAF	.201 NAF	.271 NAF	.290 NAF	.241 NAF
JUL	.413 NAF	.105 NAF	.174 NAF	.057 NAF	.178 NAF	.144 NA
AUG	.341	.173	.177	.137	.129	.111
SEP	.471	.265	.320	.322	.281	.090
OCT	.535	.356	.378	.369	.362	.372
NOV	.428	-.162	.002	.019	.017	-.120

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DRINKING WATER SURVEILLANCE PROGRAM DESERONTO WTP 1988

	WATER TREATMENT PLANT				DISTRIBUTION SYSTEM	
SITE TYPE	RAW	TREATED	CARBON 1	CARBON 2	SITE 1 STANDING	SITE 1 FREE FLOW
MAGNESIUM (MG/L)			DET'N LIMIT = .050		GUIDELINE = 30 (F2)	
JAN	4.900	5.100	.	.	5.000	5.000
	5.000	4.900	4.800	4.800	4.700	4.900
	4.700	4.800	.	4.800	.	.
MAR	4.900	4.900	.	.	4.900	4.800
APR	3.900	3.700	3.900	.	3.800	3.600
MAY	IIS	3.500	.	.	3.600	3.700
JUN	4.900	4.600	4.800	4.800	4.800	4.800
JUL	4.800	4.800	5.500	5.000	5.000	4.900
AUG	4.900	4.900	4.900	4.800	4.900	4.900
SEP	5.100	4.900	4.800	4.900	5.000	4.900
OCT	4.900	5.000	4.800	4.700	4.900	4.900
NOV	5.100	5.100	5.000	4.900	5.100	5.000
SODIUM (MG/L)			DET'N LIMIT = .200		GUIDELINE = 200 (C3)	
JAN	5.600	5.600	.	.	5.600	5.600
	5.800	5.800	5.600	5.800	5.800	5.800
	5.400	5.400	.	5.400	.	.
MAR	6.600	6.600	.	.	6.800	6.000
APR	4.600	4.400	4.400	.	4.800	4.600
MAY	IIS	4.200	.	.	4.200	4.200
JUN	5.600	5.600	5.800	5.600	5.800	5.800
JUL	6.000	6.400	6.200	6.400	6.400	6.200
AUG	6.400	6.600	6.600	6.800	6.800	6.800
SEP	6.800	6.600	6.600	6.600	6.800	6.600
OCT	6.800	6.800	6.800	6.800	6.800	7.200
NOV	6.800	7.000	7.000	7.400	7.000	7.000
AMMONIUM TOTAL (MG/L)			DET'N LIMIT = 0.002		GUIDELINE = .05 (F2)	
JAN	.026	.014	.	.	.034	.016
	.036	.016	.028	.026	.016	.018
	.012	.018	.	.018	.	.
MAR	.030	.012	.	.	.032	.014
APR	.010	.020	.068	.	.028	.026
MAY	IIS	.008 <T	.	.	.014	.016
JUN	.064	.004 <T	.012	.010	.010	.004 <T
JUL	.060	.010	.020	.016	.022	.012
AUG	.004 <T	.046	.042	.042	.054	.052
SEP	.002 <T	.002 <T	.038	.036	.006 <T	.008 <T
OCT	.056	.008 <T	.030	.040	.022	.010
NOV	.034	.008 <T	.066	.066	.020	.010

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DRINKING WATER SURVEILLANCE PROGRAM DESERONTO WTP 1988

	WATER TREATMENT PLANT				DISTRIBUTION SYSTEM	
SITE TYPE	RAW	TREATED	CARBON 1	CARBON 2	SITE 1 STANDING	SITE 1 FREE FLOW
NITRITE (MG/L)		DET'N LIMIT = 0.001		GUIDELINE = 1.000 (A1)		
JAN	.013	.002 <T	.	.	.002 <T	.001 <T
	.016	.002 <T	.003 <T	.002 <T	.002 <T	.002 <T
	.032	.002 <T	.	.002 <T	.	.
MAR	.040	.001 <T	.	.	.003 <T	.001 <T
APR	.079	.002 <T	.002 <T	.	.003 <T	.002 <T
MAY	!!S	.001 <T	.	.	.002 <T	.003 <T
JUN	.012	BDL	.001 <T	.001 <T	.001 <T	BDL
JUL	.007	.001 <T	.002 <T	.002 <T	.002 <T	.001 <T
AUG	BDL	.002 <T	.002 <T	.002 <T	.002 <T	.001 <T
SEP	.079	.001 <T	.002 <T	.002 <T	.003 <T	.002 <T
OCT	.044	.003 <T	.003 <T	.003 <T	.004 <T	.003 <T
NOV	.061	.011	.008	.003 <T	.011	.009
TOTAL NITRATES (MG/L)		DET'N LIMIT = .020		GUIDELINE = 10.000 (A1)		
JAN	.275	.290	.	.	.285	.280
	.250	.260	.255	.245	.265	.260
	.305	.280	.	.280	.	.
MAR	.365	.335	.	.	.360	.335
APR	.520	.420	.035 <T	.	.475	.425
MAY	!!S	.165	.	.	.165	.160
JUN	.120	.125	.135	.110	.135	.125
JUL	.035 <T	.130	.120	.125	.145	.130
AUG	.265	.130	.120	.145	.215	.125
SEP	.270	.185	.180	.180	.220	.180
OCT	.140	.130	.120	.120	.165	.125
NOV	.155	.140	.125	.120	.200	.135
NITROGEN TOT KJELD (MG/L)		DET'N LIMIT = .020		GUIDELINE = N/A		
JAN	.440	.290	.	.	.410	.310
	.420	.290	.280	.280	.310	.290
	.440	.340	.	.340	.	.
MAR	.440	.330	.	.	.500	.310
APR	.490	.350	.140	.	.400	.360
MAY	!!S	.240	.	.	.300	.260
JUN	.380	.050 <T	.180	.070 <T	.140	.040 <T
JUL	.560	.130	.160	.140	.190	.130
AUG	.540	.270	.330	.260	.350	.330
SEP	.720	.230	.300	.270	.240	.230
OCT	.710	.230	.270	.300	.200	.200
NOV	.720	.260	.320	.300	.290	.240

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DRINKING WATER SURVEILLANCE PROGRAM DESERONTO WTP 1988

	WATER TREATMENT PLANT				DISTRIBUTION SYSTEM	
SITE TYPE	RAW	TREATED	CARBON 1	CARBON 2	SITE 1 STANDING	FREE FLOW
PH (DIMENSIONLESS)		DET'N LIMIT = N/A		GUIDELINE = 6.5-8.5(A4)		
JAN	8.250	8.060	.	.	8.130	8.120
	8.010	7.680	7.980	8.050	8.120	7.960
	8.210	7.980	.	7.980	.	.
MAR	8.140	7.920	.	.	7.900	7.760
APR	7.950	7.860	8.530	.	7.890	7.640
MAY	!!S	8.060	.	.	8.110	8.090
JUN	8.370	8.260	8.080	8.150	8.180	8.120
JUL	8.180	7.960	8.000	7.880	8.030	8.000
AUG	8.150	8.040	8.040	8.000	8.030	7.990
SEP	8.310	8.200	8.250	8.250	8.230	8.040
OCT	8.320	8.230	8.240	8.240	8.230	8.240
NOV	8.220	7.730	7.880	7.880	7.910	7.780
PHOSPHORUS FIL REACT (MG/L)		DET'N LIMIT = .0005		GUIDELINE = N/A		
JAN	.001 <T	.000 <T	.	.	.	.
	.001 <T	.000 <T	BDL	BDL	.	.
	.002 <T	.001 <T	.	.001 <T	.	.
MAR	.001 <T	.001 <T	.	.	.	.
APR	.005	.001 <T	.013	.	.	.
MAY	!!S	.000 <T	.	.	.	.
JUN	.004	.001 <T	.001 <T	.001 <T	.	.
JUL	.002	.001 <T	.001 <T	.001 <T	.	.
AUG	.008	.001 <T	.000 <T	.001 <T	.	.
SEP	.009	.000 <T	.000 <T	BDL	.	.
OCT	.011	.002	.002 <T	.002 <T	.	.
NOV	.001 <T	.000 <T	BDL	BDL	.	.
PHOSPHORUS TOTAL (MG/L)		DET'N LIMIT = .002		GUIDELINE = .40 (F2)		
JAN	.012	.004 <T	.	.	.	.
	.014	.005 <T	.004 <T	.004 <T	.	.
	.010	.004 <T	.	.004 <T	.	.
MAR	.016	.006 <T	.	.	.	.
APR	.027	.009 <T	.014	.	.	.
MAY	!!S	.006 <T	.	.	.	.
JUN	.028	.004 <T	.020	.012	.	.
JUL	.037	.006 <T	.004 <T	.005 <T	.	.
AUG	.042	.008 <T	.011	.009 <T	.	.
SEP	.048	BDL	BDL	BDL	.	.
OCT	.052	.008 <T	.006 <T	.007 <T	.	.
NOV	.038	.004 <T	.002 <T	BDL	.	.
TOTAL SOLIDS (MG/L)		DET'N LIMIT = 1.		GUIDELINE = 500 (A3)		
JAN	184 CRO	188 CRO	.	.	189 CRO	187 CR

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DRINKING WATER SURVEILLANCE PROGRAM DESERONTO WTP 1988

	WATER TREATMENT PLANT				DISTRIBUTION SYSTEM	
SITE TYPE	RAW	TREATED	CARBON 1	CARBON 2	SITE 1 STANDING	SITE 1 FREE FLOW
SULPHATE ( )		DET'N LIMIT = N/A		GUIDELINE = N/A		
AUG	14.220	26.670	25.800	25.940	29.180	26.110
SEP	14.090	32.720	32.020	32.050	32.290	31.940
OCT	13.500	32.000	31.800	31.400	31.200	31.900
NOV	12.610	30.020	30.710	30.790	30.370	29.750
TURBIDITY (FTU)		DET'N LIMIT = .02		GUIDELINE = 1.00 (A1)		
JAN	1.300	.160	.	.	.320	.200
	.680	.280	.190	.230	.600	.260
	.740	.140	.	.140	.	.
MAR	1.020	.220	.	.	.480	.200
APR	2.900	1.800	.130	.	1.600	.700
MAY	IIS	.360	.	.	1.080	.360
JUN	1.900	.340	3.600	1.770	.450	.240
JUL	3.600	.560	.420	.160	1.600	.390
AUG	4.900	1.080	.850	.560	1.190	.500
SEP	5.700	.470	.270	.270	.950	.370
OCT	8.400	.640	.660	.400	1.100	.570
NOV	6.400	.280	1.230 RRV	.360	.970	.270
METALS *						
SILVER (UG/L)		DET'N LIMIT = N/A		GUIDELINE = .05 (A1)		
JAN	BDL	BDL	.	.	.150 <T	.030 <T
	BDL	BDL	BDL	.090 <T	.020 <T	BDL
	BDL	BDL	.	BDL	.	.
MAR	BDL	BDL	.	.	.040 <T	BDL
APR	BDL	BDL	BDL	.	.040 <T	BDL
MAY	BDL	.030 <T	.	.	.450 <T	BDL
JUN	BDL	BDL	BDL	BDL	.050 <T	BDL
JUL	BDL	BDL	BDL	.290 <T	BDL	BDL
AUG	.050 <T	.030 <T	BDL	BDL	.040 <T	BDL
SEP	BDL	.030 <T	.080 <T	.050 <T	.050 <T	.040 <T
OCT	BDL	.030 <T	BDL	.030 <T	.070 <T	BDL
NOV	.030 <T	.050 <T	.090 <T	.050 <T	.090 <T	.040 <T

Note: * All metal concentrations in:

- o µg/L for results
- o mg/L for Det'n Limit
- o mg/L for Guideline

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DRINKING WATER SURVEILLANCE PROGRAM DESERONTO WTP 1988

	WATER TREATMENT PLANT				DISTRIBUTION SYSTEM	
SITE						
TYPE	RAW	TREATED	CARBON 1	CARBON 2	SITE 1 STANDING	SITE 1 FREE FLOW
ALUMINUM (UG/L)			DET'N LIMIT = .004		GUIDELINE = .10 (A4)	
JAN	30.000	64.000	.	.	53.000	56.000
	26.000	160.000	75.000	88.000	140.000	130.000
	19.000	88.000	.	88.000	.	.
MAR	56.000	180.000	.	.	70.000	97.000
APR	84.000	800.000	360.000	.	500.000	320.000
MAY	34.000	77.000	.	.	72.000	61.000
JUN	42.000	120.000	1000.000	880.000	140.000	160.000
JUL	57.000	28.000	29.000	33.000	38.000	30.000
AUG	49.000	110.000	130.000	95.000	88.000	98.000
SEP	110.000	41.000	37.000	38.000	43.000	36.000
OCT	94.000	44.000	33.000	39.000	43.000	40.000
NOV	75.000	44.000	39.000	49.000	41.000	40.000
ARSENIC (UG/L)			DET'N LIMIT = 0.001		GUIDELINE = .050 (A1)	
JAN	1.800	.780 <T	.	.	.650 <T	.790 <T
	1.500	.920 <T	.770 <T	.870 <T	.760 <T	.800 <T
	1.000	.670 <T	.	.670 <T	.	.
MAR	.870 <T	.280 <T	.	.	.340 <T	.210 <T
APR	.800 <T	.250 <T	3.200	.	.370 <T	.200 <T
MAY	.680 <T	.500 <T	.	.	.620 <T	.420 <T
JUN	1.200	.550 <T	.640 <T	.830 <T	.350 <T	.400 <T
JUL	1.200	.260 <T	.360 <T	.690 <T	.380 <T	.380 <T
AUG	3.300	1.300	1.100	1.100	1.400	1.100
SEP	2.600	.830 <T	.740 <T	.860 <T	1.000 <T	.680 <T
OCT	2.000	.840 <T	1.100	.770 <T	1.200	.710 <T
NOV	1.100	.730 <T	.490 <T	.760 <T	.700 <T	.650 <T
BARIUM (UG/L)			DET'N LIMIT = 0.001		GUIDELINE = 1.000 (A1)	
JAN	41.000	35.000	.	.	36.000	34.000
	40.000	36.000	34.000	35.000	37.000	36.000
	42.000	39.000	.	39.000	.	.
MAR	41.000	38.000	.	.	41.000	36.000
APR	34.000	31.000	32.000	.	36.000	29.000
MAY	34.000	31.000	.	.	34.000	32.000
JUN	38.000	35.000	38.000	38.000	50.000	37.000
JUL	36.000	32.000	32.000	38.000	33.000	32.000
AUG	38.000	37.000	35.000	32.000	36.000	36.000
SEP	42.000	37.000	36.000	37.000	37.000	37.000
OCT	45.000	37.000	35.000	36.000	34.000	37.000
NOV	39.000	36.000	36.000	36.000	39.000	36.000

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DRINKING WATER SURVEILLANCE PROGRAM DESERONTO WTP 1988

	WATER TREATMENT PLANT				DISTRIBUTION SYSTEM	
SITE TYPE	RAW	TREATED	CARBON 1	CARBON 2	SITE 1 STANDING	SITE 1 FREE FLOW
BORON (UG/L) DET'N LIMIT = 0.010 GUIDELINE = 5.000 (A1)						
JAN	11.000 <T	11.000 <T	.	.	13.000 <T	11.000 <T
	13.000 <T	12.000 <T	12.000 <T	13.000 <T	13.000 <T	12.000 <T
	13.300 <T	14.600 <T	.	14.600 <T	.	.
MAR	11.000 <T	11.000 <T	.	.	12.000 <T	11.000 <T
APR	10.000 <T	13.000 <T	.630 <T	.	9.800 <T	9.000 <T
MAY	7.100 <T	6.900 <T	.	.	7.300 <T	6.500 <T
JUN	21.000	8.300 <T	14.000 <T	11.000 <T	5.900 <T	9.500 <T
JUL	17.000 <T	12.000 <T	13.000 <T	13.000 <T	18.000 <T	12.000 <T
AUG	18.000 <T	42.000	21.000	18.000 <T	42.000	40.000
SEP	18.000 <T	48.000	27.000	50.000	19.000 <T	18.000 <T
OCT	17.000 <T	34.000	26.000	22.000	16.000 <T	17.000 <T
NOV	45.000	42.000	25.000	41.000	24.000	39.000
BERYLLIUM (UG/L) DET'N LIMIT = 0.001 GUIDELINE = .0002 (N)						
JAN	BDL	BDL	.	.	BDL	BDL
	BDL	BDL	BDL	.010 <T	BDL	BDL
	BDL	.010 <T	.	.010 <T	.	.
MAR	BDL	BDL	.	.	BDL	BDL
APR	.030 <T	.030 <T	BDL	.	.030 <T	BDL
MAY	.060 <T	BDL	.	.	.020 <T	BDL
JUN	.020 <T	.020 <T	.020 <T	.020 <T	BDL	BDL
JUL	.080 <T	.030 <T	.020 <T	BDL	.020 <T	.030 <T
AUG	.020 <T	.070 <T	BDL	.020 <T	.050 <T	BDL
SEP	BDL	.100 <T	.020 <T	.080 <T	BDL	.070 <T
OCT	BDL	.040 <T	BDL	BDL	BDL	BDL
NOV	.090 <T	.090 <T	BDL	.050 <T	BDL	.090 <T
CADMIUM (UG/L) DET'N LIMIT = 0.300 GUIDELINE = 5.000 (A1)						
JAN	BDL	BDL	.	.	.070 <T	BDL
	.050 <T	BDL	BDL	BDL	BDL	BDL
	.090 <T	.090 <T	.	.090 <T	.	.
MAR	BDL	BDL	.	.	.060 <T	BDL
APR	BDL	BDL	BDL	.	.060 <T	BDL
MAY	BDL	BDL	.	.	.070 <T	BDL
JUN	BDL	BDL	BDL	.070 <T	.210 <T	BDL
JUL	BDL	BDL	BDL	BDL	.080 <T	BDL
AUG	BDL	BDL	BDL	BDL	BDL	BDL
SEP	BDL	BDL	BDL	BDL	BDL	BDL
OCT	BDL	BDL	BDL	BDL	.080 <T	BDL
NOV	BDL	BDL	BDL	BDL	.060 <T	BDL

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DRINKING WATER SURVEILLANCE PROGRAM DESERONTO WTP 1988

	WATER TREATMENT PLANT				DISTRIBUTION SYSTEM	
SITE TYPE	RAW	TREATED	CARBON 1	CARBON 2	SITE 1 STANDING	SITE 1 FREE FLOW
COBALT (UG/L)			**DET'N LIMIT = 0.001**		**GUIDELINE = 1.0 (N)**	
JAN	.160 <T	.120 <T	.	.	.130 <T	.100 <T
	.230 <T	.160 <T	.150 <T	.080 <T	.210 <T	.180 <T
	.120 <T	.160 <T	.	.160 <T	.	.
MAR	BDL	BDL	.	.	BDL	BDL
APR	.570 <T	.520 <T	.470 <T	.	.490 <T	.470 <T
MAY	.140 <T	.100 <T	.	.	.170 <T	.080 <T
JUN	.150 <T	.070 <T	.100 <T	.140 <T	.110 <T	.080 <T
JUL	.220 <T	.090 <T	.410 <T	.160 <T	.120 <T	.110 <T
AUG	.240 <T	.120 <T	.130 <T	.110 <T	.430 <T	.160 <T
SEP	.320 <T	.100 <T	.210 <T	.140 <T	.140 <T	.150 <T
OCT	.390 <T	.190 <T	.130 <T	.210 <T	.140 <T	.160 <T
NOV	.370 <T	.140 <T	.110 <T	.260 <T	.150 <T	.120 <T
CHROMIUM (UG/L)			**DET'N LIMIT = 0.001**		**GUIDELINE = .05 (A1)**	
JAN	.120 <T	BDL	.	.	2.500	BDL
	.190 <T	BDL	BDL	.130 <T	.490 <T	BDL
	1.300	2.040	.	2.040	.	.
MAR	.180 <T	BDL	.	.	.100 <T	BDL
APR	.380 <T	1.100	.120 <T	.	.170 <T	.110 <T
MAY	.360 <T	.210 <T	.	.	.210 <T	.180 <T
JUN	2.200	1.300	2.900	2.400	.270 <T	1.600
JUL	.910 <T	.290 <T	.500 <T	BDL	.400 <T	.300 <T
AUG	.180 <T	3.400	.530 <T	.150 <T	3.000	3.000
SEP	.160 <T	2.800	1.000 <T	3.000	.260 <T	.160 <T
OCT	.350 <T	5.100	2.800	2.300	.320 <T	.340 <T
NOV	6.100	5.300	1.300	4.600	.510 <T	4.600
COPPER (UG/L)			**DET'N LIMIT = .001**		**GUIDELINE = 1.0 (A3)**	
JAN	.860 <T	.620 <T	.	.	130.000	9.300
	1.200	.920 <T	.430 <T	.470 <T	140.000	9.300
	.850 <T	.420 <T	.	.420 <T	.	.
MAR	.900 <T	1.100	.	.	180.000	11.000
APR	.850 <T	1.100	.180 <T	.	150.000	9.500
MAY	2.700	.950 <T	.	.	140.000	12.000
JUN	1.300	.630 <T	.410 <T	.300 <T	110.000	20.000
JUL	1.300	.860 <T	.290 <T	.310 <T	140.000	11.000
AUG	.840 <T	.790 <T	.300 <T	.200 <T	100.000	12.000
SEP	1.900	.820 <T	.400 <T	.490 <T	160.000	22.000
OCT	.740 <T	.640 <T	.270 <T	.290 <T	160.000	21.000
NOV	.710 <T	1.500	.580 <T	.750 <T	140.000	12.000

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DRINKING WATER SURVEILLANCE PROGRAM DESERONTO WTP 1988

	WATER TREATMENT PLANT				DISTRIBUTION SYSTEM	
SITE TYPE	RAW	TREATED	CARBON 1	CARBON 2	SITE 1 STANDING	SITE 1 FREE FLOW
IRON (UG/L)		DET'N LIMIT = .002		GUIDELINE = .300 (A3)		
JAN	82.000	16.000 <T	.	.	33.000 <T	8.500 <T
	59.000	11.000 <T	BDL	7.400 <T	58.000	6.000 <T
	58.000	7.780 <T	.	7.780 <T	.	.
MAR	95.000	16.000 <T	.	.	92.000	7.100 <T
APR	190.000	63.000	7.500 <T	.	210.000	29.000 <T
MAY	100.000	20.000 <T	.	.	270.000	10.000 <T
JUN	94.000	5.600 <T	31.000 <T	28.000 <T	61.000	19.000 <T
JUL	130.000	18.000 <T	6.900 <T	BDL	230.000	6.900 <T
AUG	100.000	20.000 <T	5.300 <T	6.900 <T	230.000	8.700 <T
SEP	210.000	12.000 <T	6.600 <T	BDL	260.000	8.000 <T
OCT	150.000	9.300 <T	BDL	BDL	260.000	BDL
NOV	130.000	6.100 <T	7.100 <T	BDL	180.000	5.700 <T
MERCURY (UG/L)		DET'N LIMIT = 0.010		GUIDELINE = 1.000 (A1)		
JAN	BDL	BDL	.	.	.	.010
	.040	.010	.010	.020	.	BDL
	ISS	ISS	.	ISS	.	.
MAR	.020	.020	.	.	.	.010
APR	.010	BDL	BDL	.	.	.020
MAY	.050	.020	.	.	.	.030
JUN	.020 <T	.020 <T	.300	.030 <T	.	.020 <T
JUL	.040 <T	.040 <T	.050 <T	.030 <T	.	.020 <T
AUG	.050 <T	.080	.050 <T	.030 <T	.	.040 <T
SEP	.050 <T	.040 <T	.060	.070	.	.040 <T
OCT	.090	.030 <T	.040 <T	.030 <T	.	.040 <T
NOV	.100	.060	.090	.080	.	.040 <T
MANGANESE (UG/L)		DET'N LIMIT = .001		GUIDELINE = .050 (A3)		
JAN	8.700	1.700	.	.	2.500	1.300
	9.600	4.000	2.400	2.000	4.900	3.400
	9.400	1.960	.	1.960	.	.
MAR	12.500	5.200	.	.	7.000	4.400
APR	19.000	9.100	4.100	.	10.000	5.700
MAY	20.000	3.500	.	.	6.300	3.000
JUN	26.000	3.000	11.000	11.000	4.000	2.700
JUL	42.000	1.800	1.300	1.300	5.500	1.200
AUG	59.000	5.200	4.700	4.200	12.000	5.200
SEP	81.000	2.200	1.400	1.200	4.900	1.600
OCT	68.000	4.800	.910	3.300	6.600	3.900
NOV	33.000	1.600	1.300	1.500	4.200	1.200

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DRINKING WATER SURVEILLANCE PROGRAM DESERONTO WTP 1988

	WATER TREATMENT PLANT				DISTRIBUTION SYSTEM	
SITE TYPE	RAW	TREATED	CARBON 1	CARBON 2	SITE 1 STANDING	SITE 1 FREE FLOW
MOLYBDENUM (UG/L)		DET'N LIMIT = 0.001		GUIDELINE = .50 (N)		
JAN	.330 <T	.300 <T	.	.	.310 <T	.330 <T
	.270 <T	.270 <T	.270 <T	.330 <T	.290 <T	.250 <T
	.300 <T	.280 <T	.	.280 <T	.	.
MAR	.250 <T	.290 <T	.	.	.300 <T	.260 <T
APR	.150 <T	.210 <T	.810	.	.170 <T	.190 <T
MAY	.240 <T	.280 <T	.	.	.240 <T	.250 <T
JUN	.370 <T	.060 <T	.100 <T	.050 <T	.100 <T	.090 <T
JUL	.360 <T	.420 <T	.420 <T	.540	.380 <T	.360 <T
AUG	.430 <T	.690	.660	.750	.670	.680
SEP	.420 <T	.440 <T	.480 <T	.460 <T	.450 <T	.490 <T
OCT	.430 <T	.510	.540	.490 <T	.470 <T	.460 <T
NOV	.380 <T	.490 <T	.480 <T	.480 <T	.470 <T	.520
NICKEL (UG/L)		DET'N LIMIT = 0.001		GUIDELINE = .05 (F3)		
JAN	.880 <T	.830 <T	.	.	1.900	.440 <T
	1.800	1.400	1.700	BDL	2.400	1.800
	.200 <T	.200 <T	.	.200 <T	.	.
MAR	BDL	BDL	.	.	.720 <T	BDL
APR	2.000	2.000	1.700	.	3.200	1.400
MAY	3.100	1.000 <T	.	.	1.600 <T	.660 <T
JUN	.370 <T	.120 <T	BDL	.450 <T	2.100	.150 <T
JUL	.990 <T	.500 <T	.780 <T	1.000 <T	3.000	.580 <T
AUG	.720 <T	.490 <T	.160 <T	.470 <T	8.700	.370 <T
SEP	.660 <T	.130 <T	.540 <T	.650 <T	7.500	.390 <T
OCT	BDL	BDL	.380 <T	BDL	3.500	BDL
NOV	BDL	BDL	BDL	.120 <T	64.000	BDL
LEAD (UG/L)		DET'N LIMIT = 0.003		GUIDELINE = .050 (A1)		
JAN	.390	.200	.	.	2.100	.300
	.250	BDL	BDL	.180 <T	1.800	.050 <T
	.290	.060 <T	.	.060 <T	.	.
MAR	.250	.140 <T	.	.	2.500	.220
APR	.340	.310	070 <T	.	3.200	.320
MAY	.930	.210	.	.	2.200	.270
JUN	.370	.230	.130 <T	.190 <T	2.200	.570
JUL	.560	.420	BDL	.040 <T	2.500	.270
AUG	.360	.330	BDL	BDL	3.400	.430
SEP	.820	.470	.070 <T	.050 <T	3.300	.660
OCT	.750	.460	.070 <T	.130 <T	2.500	.500
NOV	.620	.430	.240	.060 <T	3.100	.380

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DRINKING WATER SURVEILLANCE PROGRAM DESERONTO WTP 1988

	WATER TREATMENT PLANT				DISTRIBUTION SYSTEM	
SITE TYPE	RAW	TREATED	CARBON 1	CARBON 2	SITE 1 STANDING	SITE 1 FREE FLOW
ANTIMONY (UG/L)			**DET'N LIMIT = N/A**		**GUIDELINE = N/A**	
JAN	.080 <T	.090 <T	.	.	.120 <T	.080 <T
	.100 <T	.050 <T	.070 <T	.130 <T	.100 <T	.060 <T
	.120 <T	.110 <T	.	.110 <T	.	.
MAR	.050 <T	.070 <T	.	.	.070 <T	.020 <T
APR	.070 <T	.100 <T	.290	.	.090 <T	.090 <T
MAY	.130 <T	.090 <T	.	.	.140 <T	.060 <T
JUN	.150 <T	.150 <T	.170 <T	.160 <T	.200 <T	.160 <T
JUL	.140 <T	.160 <T	.160 <T	.140 <T	.170 <T	.130 <T
AUG	.580	.660	.460	.110 <T	1.100	.690
SEP	.410	.470	.650	.520	.600	.480
OCT	.480	.500	.530	.500	.460	.660
NOV	.490	.610	.630	.920	.630	.620
SELENIUM (UG/L)			**DET'N LIMIT = 0.001**		**GUIDELINE = .010 (A1)**	
JAN	.510 <T	.680 <T	.	.	.390 <T	.290 <T
	.570 <T	.550 <T	BDL	.640 <T	.630 <T	BDL
	.410 <T	.300 <T	.	.300 <T	.	.
MAR	.290 <T	.360 <T	.	.	.690 <T	.450 <T
APR	BDL	BDL	BDL	.	.290 <T	BDL
MAY	.730 <T	.500 <T	.	.	.660 <T	.930 <T
JUN	BDL	.350 <T	BDL	BDL	.640 <T	.470 <T
JUL	.220 <T	BDL	.670 <T	1.400 <T	1.500 <T	.610 <T
AUG	1.100 <T	.480 <T	.850 <T	1.200 <T	.920 <T	.880 <T
SEP	1.200 <T	.290 <T	.870 <T	BDL	1.400 <T	.290 <T
OCT	.230 <T	1.600 <T	BDL	.230 <T	1.800 <T	.750 <T
NOV	1.000 <T	.670 <T	BDL	1.200 <T	1.500 <T	1.500 <T
STRONTIUM (UG/L)			**DET'N LIMIT = .001**		**GUIDELINE = 2.00 (H)**	
JAN	210.000	210.000	.	.	200.000	200.000
	200.000	200.000	200.000	220.000	200.000	200.000
	224.000	237.000	.	237.000	.	.
MAR	202.000	200.000	.	.	210.000	200.000
APR	170.000	170.000	160.000	.	180.000	160.000
MAY	150.000	150.000	.	.	160.000	150.000
JUN	220.000	190.000	210.000	220.000	200.000	210.000
JUL	190.000	180.000	190.000	200.000	190.000	180.000
AUG	190.000	190.000	180.000	180.000	180.000	190.000
SEP	200.000	190.000	190.000	190.000	190.000	200.000
OCT	190.000	170.000	170.000	180.000	180.000	170.000
NOV	170.000	170.000	170.000	170.000	180.000	170.000

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DRINKING WATER SURVEILLANCE PROGRAM DESERONTO WTP 1988

	WATER TREATMENT PLANT				DISTRIBUTION SYSTEM	
SITE TYPE	RAW	TREATED	CARBON 1	CARBON 2	SITE 1 STANDING	SITE 1 FREE FLOW
TITANIUM (UG/L)		DET'N LIMIT = N/A		GUIDELINE = N/A		
JAN	5.700	3.500	.	.	3.800	3.400
	8.900	6.900	6.800	6.600	6.900	7.000
	5.600	4.000	.	4.000	.	.
MAR	12.000	11.000	.	.	11.000	10.000
APR	19.000	14.000	11.000	.	13.000	12.000
MAY	6.200	3.400	.	.	3.900	3.800
JUN	4.900	2.600	3.500	3.300	2.600	2.800
JUL	7.400	4.200	4.000	4.200	4.800	4.200
AUG	13.000	10.000	11.000	9.900	11.000	10.000
SEP	13.000	5.800	5.700	5.900	6.000	5.300
OCT	9.400	2.100	2.100	2.200	2.400	2.800
NOV	5.200	.450 <T	.560 <T	.660 <T	.670 <T	1.100 <T
THALLIUM (UG/L)		DET'N LIMIT = N/A		GUIDELINE = N/A		
JAN	.020 <T	.010 <T	.	.	.030 <T	.020 <T
	BDL	BDL	BDL	BDL	BDL	BDL
	.010 <T	.030 <T	.	.030 <T	.	.
MAR	BDL	BDL	.	.	BDL	BDL
APR	BDL	BDL	BDL	.	BDL	BDL
MAY	BDL	BDL	.	.	BDL	BDL
JUN	.020 <T	BDL	.020 <T	BDL	BDL	.030 <T
JUL	BDL	BDL	BDL	BDL	BDL	BDL
AUG	BDL	BDL	BDL	BDL	.020 <T	BDL
SEP	BDL	BDL	BDL	BDL	BDL	BDL
OCT	BDL	BDL	BDL	BDL	BDL	BDL
NOV	.020 <T	BDL	BDL	BDL	BDL	.020 <T
URANIUM (UG/L)		DET'N LIMIT = .02		GUIDELINE = 20. (A2)		
JAN	.300	.200	.	.	.200	.200
	.320	.200	.210	.280	.200	.270
	.430	.240	.	.240	.	.
MAR	.230	.080 <T	.	.	.100 <T	.090 <T
APR	.270	.130 <T	.070 <T	.	.110 <T	.110 <T
MAY	.280	.100 <T	.	.	.070 <T	.080 <T
JUN	.310	.030 <T	.080 <T	.100 <T	.040 <T	.040 <T
JUL	.220	BDL	BDL	BDL	BDL	BDL
AUG	.220	.040 <T	BDL	BDL	.030 <T	BDL
SEP	.230	BDL	BDL	BDL	.050 <T	.030 <T
OCT	.250	.040 <T	.080 <T	.030 <T	BDL	BDL
NOV	.260	.070 <T	.100 <T	.060 <T	.070 <T	.070 <T

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DRINKING WATER SURVEILLANCE PROGRAM DESERONTO WTP 1988

	WATER TREATMENT PLANT				DISTRIBUTION SYSTEM	
SITE TYPE	RAW	TREATED	CARBON 1	CARBON 2	SITE 1 STANDING	SITE 1 FREE FLOW
VANADIUM (UG/L)		DET'N LIMIT = .001		GUIDELINE = .10 (N)		
JAN	.340 <T	.240 <T	.	.	.320 <T	.250 <T
	.250 <T	.180 <T	.160 <T	.200 <T	.270 <T	.180 <T
	.330 <T	.260 <T	.	.260 <T	.	.
MAR	.250 <T	.140 <T	.	.	.230 <T	.130 <T
APR	.550	.360 <T	.390 <T	.	.400 <T	.290 <T
MAY	.420 <T	.250 <T	.	.	.360 <T	.230 <T
JUN	.410 <T	.070 <T	.110 <T	.100 <T	.110 <T	.070 <T
JUL	.690	.190 <T	.220 <T	.230 <T	.290 <T	.200 <T
AUG	.870	.680	.710	.720	.700	.630
SEP	.980	.470 <T	.420 <T	.420 <T	.580	.410 <T
OCT	.830	.490 <T	.430 <T	.420 <T	.590	.400 <T
NOV	.530	.180 <T	.190 <T	.200 <T	.330 <T	.210 <T
ZINC (UG/L)		DET'N LIMIT = .001		GUIDELINE = 5.00 (A3)		
JAN	3.700	1.200	.	.	190.000	8.200
	1.600	.760 <T	.430 <T	3.300	180.000	8.900
	1.300	.690 <T	.	.690 <T	.	.
MAR	2.280	2.200	.	.	240.000	11.000
APR	2.200	2.100	.560 <T	.	180.000	11.000
MAY	3.800	2.500	.	.	170.000	11.000
JUN	2.300	2.100	1.500	1.600	130.000	14.000
JUL	3.300	3.700	1.200	1.000 <T	170.000	7.200
AUG	1.800	3.100	.450 <T	.600 <T	130.000	6.900
SEP	3.100	2.900	1.300	1.200	210.000	18.000
OCT	1.900	2.300	.910 <T	.800 <T	250.000	14.000
NOV	1.600	2.000	1.000 <T	1.200	220.000	9.000

Table I-3

DRINKING WATER SURVEILLANCE PROGRAM DESERONTO WTP 1988

	WATER TREATMENT PLANT				DISTRIBUTION SYSTEM	
SITE TYPE	RAW	TREATED	CARBON 1	CARBON 2	SITE 1 STANDING	SITE 1 FREE FLOW
CHLOROPHENOLS						
246-TRICHLOROPHENOL (NG/L)		DET'N LIMIT = 50.		GUIDELINE = 5000 (B1)		
JUN	BDL	30.000 <T	.	.	.	.
PESTICIDES & PCB						
ALPHA BHC (NG/L)		DET'N LIMIT = 1.000		GUIDELINE = 700 (G)		
JAN	1.000 <T	1.000 <T	.	.	.	1.000 <T
	BDL	BDL	BDL	BDL	.	BDL
	1.000 <T	1.000 <T	.	1.000 <T	.	.
MAR	BDL	BDL	.	.	.	BDL
APR	BDL	BDL	BDL	.	.	4.000 <T
MAY	BDL	BDL	.	.	.	1.000 <T
JUN	BDL	BDL	BDL	BDL	.	BDL
JUL	BDL	BDL	BDL	BDL	.	BDL
AUG	!LA	BDL	BDL	BDL	.	BDL
SEP	BDL	BDL	BDL	BDL	.	BDL
OCT	BDL	BDL	BDL	BDL	.	BDL
LINDANE (NG/L)		DET'N LIMIT = 1.000		GUIDELINE = 4000 (A1)		
JAN	BDL	BDL	.	.	.	BDL
	BDL	BDL	BDL	BDL	.	BDL
	BDL	BDL	.	BDL	.	.
MAR	BDL	BDL	.	.	.	BDL
APR	BDL	BDL	BDL	.	.	4.000 <T
MAY	BDL	BDL	.	.	.	BDL
JUN	BDL	BDL	BDL	BDL	.	BDL
JUL	BDL	BDL	BDL	BDL	.	BDL
AUG	!LA	BDL	BDL	BDL	.	BDL
SEP	BDL	BDL	BDL	BDL	.	BDL
OCT	BDL	BDL	BDL	BDL	.	BDL

Table I-3

DRINKING WATER SURVEILLANCE PROGRAM DESERONTO WTP 1988

	WATER TREATMENT PLANT				DISTRIBUTION SYSTEM	
SITE TYPE	RAW	TREATED	CARBON 1	CARBON 2	SITE 1 STANDING	SITE 1 FREE FLOW
PHENOLICS						
PHENOLICS (UG/L)		DET'N LIMIT = 0.2		GUIDELINE = 2.00 (A3)		
JAN	.600 <T	.600 <T	.	.	.	.
	BDL	BDL	BDL	BDL	.	.
	BDL	.600 <T	.	.600 <T	.	.
MAR	BDL	BDL	.	.	.	.
APR	BDL	BDL	BDL	.	.	.
MAY	.600 <T	.800 <T	.	.	.	.
JUN	2.000	.200 <T	.800 <T	.400 <T	.	.
JUL	1.600	.200 <T	.200 <T	BDL	.	.
AUG	1.600	1.400	1.400	1.000	.	.
SEP	1.200	BDL	BDL	BDL	.	.
OCT	2.800	1.800	1.600	1.600	.	.
NOV	3.000	1.600	1.400	1.400	.	.
VOLATILES						
BENZENE (UG/L)		DET'N LIMIT = .050		GUIDELINE = 5.0 (B1)		
JAN	!AM	!AM	.	.	.	!AM
	BDL	BDL	.	BDL	.	.
APR	BDL	BDL	BDL	.	.	BDL
MAY	BDL	BDL	.	.	.	BDL
JUN	BDL	BDL	BDL	BDL	.	BDL
JUL	.050 <T	.050 <T	BDL	BDL	.	BDL
AUG	BDL	BDL	BDL	BDL	.	BDL
SEP	BDL	BDL	BDL	BDL	.	BDL
OCT	BDL	BDL	BDL	BDL	.	BDL
NOV	BDL	BDL	BDL	BDL	.	BDL
TOLUENE (UG/L)		DET'N LIMIT = .050		GUIDELINE = 24.0 (B4)		
JAN	!AM	!AM	.	.	.	!AM
	BDL	BDL	.	BDL	.	.
APR	BDL	.100 <T	BDL	.	.	.050 <T
MAY	BDL	BDL	.	.	.	BDL
JUN	BDL	BDL	BDL	BDL	.	BDL
JUL	BDL	.050 <T	BDL	BDL	.	BDL
AUG	BDL	BDL	BDL	BDL	.	BDL
SEP	BDL	BDL	BDL	BDL	.	BDL
OCT	BDL	.050 <T	BDL	BDL	.	.050 <T
NOV	BDL	BDL	BDL	BDL	.	BDL

Table I-3

DRINKING WATER SURVEILLANCE PROGRAM DESERONTO WTP 1988

	WATER TREATMENT PLANT				DISTRIBUTION SYSTEM	
SITE TYPE	RAW	TREATED	CARBON 1	CARBON 2	SITE 1 STANDING	SITE 1 FREE FLOW
ETHYLBENZENE (UG/L)		DET'N LIMIT = .050		GUIDELINE = 2.4 (84)		
JAN	!AV	!AV	.	.	.	!AV
	BDL	BDL	.	BDL	.	.
APR	BDL	BDL	BDL	.	.	BDL
MAY	BDL	.150 <T	.	.	.	BDL
JUN	BDL	.200 <T	BDL	BDL	.	.050 <T
JUL	BDL	.100 <T	BDL	BDL	.	.100 <T
AUG	BDL	.100 <T	BDL	BDL	.	BDL
SEP	SDL	.050 <T	BDL	BDL	.	BDL
OCT	BDL	.150 <T	BDL	BDL	.	BDL
NOV	BDL	BDL	.050 <T	.050 <T	.	BDL
M-XYLENE (UG/L)		DET'N LIMIT = .100		GUIDELINE = 300 (84)		
JAN	!AV	!AV	.	.	.	!AV
	BDL	BDL	.	BDL	.	.
APR	BDL	BDL	BDL	.	.	BDL
MAY	BDL	BDL	.	.	.	BDL
JUN	BDL	.200 <T	BDL	BDL	.	BDL
JUL	BDL	BDL	BDL	BDL	.	BDL
AUG	BDL	BDL	BDL	BDL	.	BDL
SEP	BDL	.100 <T	BDL	BDL	.	BDL
OCT	BDL	BDL	BDL	BDL	.	BDL
NOV	BDL	BDL	BDL	.100 <T	.	BDL
O-XYLENE (UG/L)		DET'N LIMIT = .050		GUIDELINE = 300 (84)		
JAN	!AV	!AV	.	.	.	!AV
	BDL	BDL	.	BDL	.	.
APR	BDL	.050 <T	BDL	.	.	BDL
MAY	BDL	BDL	.	.	.	BDL
JUN	BDL	.150 <T	BDL	BDL	.	BDL
JUL	BDL	BDL	BDL	BDL	.	BDL
AUG	BDL	BDL	BDL	BDL	.	BDL
SEP	BDL	.050 <T	BDL	BDL	.	BDL
OCT	BDL	.050 <T	BDL	BDL	.	BDL
NOV	BDL	BDL	BDL	BDL	.	BDL
STYRENE (UG/L)		DET'N LIMIT = N/A		GUIDELINE = N/A		
OCT	BDL	.050 <T	.200 <T	BDL	.	BDL
NOV	BDL	BDL	.300 <T	.150 <T	.	BDL

Table I-3

DRINKING WATER SURVEILLANCE PROGRAM DESERONTO WTP 1988

SITE TYPE	WATER TREATMENT PLANT RAW	TREATED	CARBON 1	CARBON 2	DISTRIBUTION SYSTEM SITE 1 STANDING	FREE FLOW
CHLOROFORM (UG/L)		DET'N LIMIT = .100		GUIDELINE = 350 (A1+)		
JAN	!AW	!AW	.	.	.	!AW
	.200 <T	.200 <T	.	.200 <T	.	.
APR	.200 <T	123.000	.300 <T	.	.	97.300
MAY	.700 <T	93.000	.	.	.	84.700
JUN	BDL	15.500	BDL	BDL	.	17.100
JUL	.400 <T	23.700	BDL	.500 <T	.	25.200
AUG	.300 <T	5.000	BDL	.500 <T	.	2.700
SEP	.100 <T	39.700	.100 <T	BDL	.	40.100
OCT	BDL	49.100	BDL	BDL	.	49.500
NOV	BDL	41.300	.300 <T	.100 <T	.	43.500
111, TRICHLOROETHANE (UG/L)		DET'N LIMIT = .020		GUIDELINE = 200 (D1)		
JAN	!AW	!AW	.	.	.	!AW
	.040 <T	.060 <T	.	.060 <T	.	.
APR	BDL	BDL	BDL	.	.	BDL
MAY	BDL	BDL	.	.	.	BDL
JUN	BDL	BDL	BDL	BDL	.	BDL
JUL	BDL	BDL	BDL	BDL	.	BDL
AUG	BDL	BDL	BDL	BDL	.	BDL
SEP	BDL	BDL	BDL	BDL	.	BDL
OCT	BDL	BDL	BDL	BDL	.	BDL
NOV	BDL	BDL	BDL	BDL	.	BDL
DICHLOROBROMOMETHANE (UG/L)		DET'N LIMIT = .050		GUIDELINE = 350 (A1+)		
JAN	!AW	!AW	.	.	.	!AW
	BDL	BDL	.	BDL	.	.
APR	.200 <T	7.300	BDL	.	.	6.650
MAY	.450 <T	8.000	.	.	.	5.550
JUN	BDL	6.300	BDL	BDL	.	6.900
JUL	BDL	9.950	BDL	.100 <T	.	9.550
AUG	.200 <T	1.900	BDL	.200 <T	.	.600
SEP	.050 <T	8.950	BDL	BDL	.	8.700
OCT	BDL	8.450	BDL	BDL	.	8.500
NOV	BDL	9.450	BDL	BDL	.	9.550

Table I-3

DRINKING WATER SURVEILLANCE PROGRAM DESERONTO WTP 1988

SITE	WATER TREATMENT PLANT				DISTRIBUTION SYSTEM	
TYPE	RAW	TREATED	CARBON 1	CARBON 2	SITE 1	
					STANDING	FREE FLOW
CHLORODIBROMOMETHANE (UG/L) DET'N LIMIT = .100 GUIDELINE = 350 (A1+)						
JAN	!AW	!AW	.	.	.	!AW
	BDL	BDL	.	BDL	.	.
APR	BDL	.500 <T	BDL	.	.	.600 <T
MAY	.300 <T	.300 <T	.	.	.	BDL
JUN	BDL	2.500	BDL	BDL	.	2.300
JUL	BDL	3.300	BDL	.100 <T	.	2.600
AUG	.200 <T	.500 <T	BDL	BDL	.	.200 <T
SEP	BDL	.900 <T	BDL	BDL	.	.900 <T
OCT	BDL	1.400	BDL	BDL	.	.700 <T
NOV	BDL	.800	BDL	BDL	.	1.900
T-CHLOROETHYLENE (UG/L) DET'N LIMIT = .050 GUIDELINE = 10.0 (C2)						
JAN	!AW	!AW	.	.	.	!AW
	BDL	BDL	.	BDL	.	.
APR	BDL	.100 <T	BDL	.	.	BDL
MAY	BDL	BDL	.	.	.	BDL
JUN	BDL	BDL	BDL	BDL	.	BDL
JUL	BDL	.050 <T	BDL	BDL	.	BDL
AUG	BDL	BDL	BDL	BDL	.	BDL
SEP	BDL	BDL	BDL	BDL	.	BDL
OCT	BDL	BDL	BDL	BDL	.	.050 <T
NOV	BDL	.050 <T	BDL	BDL	.	BDL
1,4 DICHLOROBENZENE (UG/L) DET'N LIMIT = .100 GUIDELINE = 5.0 (B1)						
JAN	!AW	!AW	.	.	.	!AW
	BDL	BDL	.	BDL	.	.
APR	BDL	BDL	BDL	.	.	BDL
MAY	BDL	BDL	.	.	.	BDL
JUN	BDL	BDL	BDL	BDL	.	BDL
JUL	BDL	BDL	BDL	BDL	.	BDL
AUG	BDL	BDL	BDL	BDL	.	BDL
SEP	BDL	BDL	BDL	BDL	.	BDL
OCT	BDL	BDL	BDL	.100 <T	.	BDL
NOV	BDL	BDL	.200 <T	.200 <T	.	BDL
TOTL TRIHALOMETHANES (UG/L) DET'N LIMIT = .500 GUIDELINE = 350 (A1)						
JAN	!AW	!AW	.	.	.	!AW
	.200	.200	.	.200	.	.
APR	BDL	130.800	BDL	.	.	104.550
MAY	1.450 <T	101.300	.	.	.	90.250
JUN	BDL	24.300	BDL	BDL	.	26.300
JUL	BDL	36.950	BDL	.700 <T	.	37.350
AUG	.700 <T	7.400	BDL	.700 <T	.	3.500 <T
SEP	BDL	49.550	BDL	BDL	.	49.700
OCT	BDL	58.950	BDL	BDL	.	58.700
NOV	BDL	51.550	BDL	BDL	.	54.950

KEY TO DRINKING WATER SURVEILLANCE PROGRAM TABLE I-3

A ONTARIO DRINKING WATER OBJECTIVES

1. Maximum Acceptable Concentration (MAC)

1+. MAC for Total Trihalomethanes

1*. MAC for Bacteriological Analyses
Poor water quality is indicated when :
- total coliform counts > 0 < 5
- P/A Bottle Test is present after 48 hours
- Aeromonas organisms are detected in more than 25% of samples in a single submission or in successive submissions from the same sampling site
- Pseudomonas Aeruginosa, Staphylococcus Aureus and members of the Fecal Streptococcus group should not be detected in any sample
- Standard Plate Count should not exceed 500 organisms per ml at 35 ^{0}C within 48 hours

2. Interim Maximum Acceptable Concentration (IMAC)
3. Maximum Desirable Concentration (MDC)
4. Aesthetic or Recommended Operational Guideline
- hardness levels between 80 and 100 mg/L as calcium carbonate are considered to provide an acceptable balance between corrosion and incrustation, water supplies with a hardness >200 mg/L are considered poor and those in excess of 500 mg/L are unacceptable.

B HEALTH & WELFARE CANADA
1. Maximum Acceptable Concentration (MAC)
2. Proposed MAC
3. Interim MAC
4. Aesthetic Objective (AO) (for xylenes, the AO is a total)

C WORLD HEALTH ORGANIZATION
1. Guideline Value (GV)
2. Tentative GV
3. Aesthetic GV

D US ENVIRONMENTAL PROTECTION AGENCY (EPA)
1. Maximum Contaminant Level (MCL)
2. Suggested No-Adverse Effect Level (SNAEL)
3. Lifetime Health Advisory
4. EPA Ambient Water Quality Criteria

F EUROPEAN ECONOMIC COMMUNITY (EEC)
1. Health Related Guideline Level
2. Aesthetic Guideline Level
3. Maximum Admissable Concentration (MADC)

G CALIFORNIA STATE DEPARTMENT OF HEALTH-GUIDELINE VALUE

H USSR MAXIMUM PERMISSIBLE CONCENTRATION

I NEW YORK STATE AMBIENT WATER GUIDELINE

N/A NONE AVAILABLE

LABORATORY RESULTS, REMARK DESCRIPTIONS

.	No Sample Taken
BDL	Below Minimum Measurable Amount
<T	Greater Than Detection Limit But Not Confident
>	Results Are Greater Than The Upper Limit
<=>	Approximate Result
!AW	No Data: Analysis Withdrawn
!CR	No Data: Could Not Confirm By Reanalysis
!CS	No Data: Contamination Suspected
!IL	No Data: Sample Incorrectly Labelled
!IS	No Data: Insufficient Sample
!LA	No Data: Laboratory Accident
!LD	No Data: Test Queued After Sample Discarded
!NA	No Data: No Authorization To Perform Reanalysis
!NP	No Data: No Procedure
!NR	No Data: Sample Not Received
!OP	No Data: Obscured Plate
!PE	No Data: Procedural Error - Sample Discarded
!PH	No Data: Sample pH Outside Valid Range
!RO	No Data: See Attached Report (no numeric results)
!SM	No Data: Sample Missing
!SS	No Data: Send Separate Sample Properly Preserved
!UI	No Data: Indeterminant Interference
A3C	Approximate, Total Count Exceeded 300 Colonies
APL	Additional Peak, Large, Not Priority Pollutant
APS	Additional Peak, Less Than, Not Priority Pollutant
CIC	Possible Contamination, Improper Cap
CRO	Calculated Result Only

PPS	Test Performed On Preserved Sample
RMP	P and M-Xylene Not Separated
RRV	Rerun Verification
RVU	Reported Value Unusual
SPS	Several Peaks, Small, Not Priority Pollutant
UAL	Unreliable: Sample Age Exceeds Normal Limit
UCR	Unreliable: Could Not Confirm By Reanalysis
UCS	Unreliable: Contamination Suspected
UIN	Unreliable: Indeterminant Interference
XP	Positive After X Number of Hours

Appendix II

BACTERIOLOGICAL WATER QUALITY DATA AT DESERONTO WATER TREATMENT PLANT

Table II-1
BACTERIOLOGICAL TESTING RESULTS

Month	R/T	Total Coliform					Fecal Coliform					Fecal Streptococcus			
		Absent	1-5	6-100	101-3000	>3000	Absent	1-5	6-10	11-500	>500	Absent	1	2-50	>50
1987															
Jan	R			1					1				1		
	T	1					1					1			
Feb	R			2					2				2		
	T	2					2					2			
Mar	R			4					4				4		
	T	4					4					4			
Apr	R			3	1				3	1			4		
	T	4					4					4			
May	R			4					4						
	T	4					4					4			
Jun	R			5					5				5		
	T	5					5					5			
Jul	R			3	1				4				4		
	T	4					4					4			
Aug	R			3	1				4				4		
	T	4					4					4			
Sep	R			5					4	1			5		
	T	5					5					5			
Oct	R			4					3	1			4		
	T	4					4					4			
Nov	R			3	1				3	1			4		
	T	4					4					4			
Dec	R			1					1				1		
	T	1					1					1			
1986															
Jan	R														
	T														
Feb	R			4					4				4		
	T	4					4					4			
Mar	R			3	1				4				4		
	T	4					4					4			
Apr	R			5					5				5		
	T	5					5					5			
May	R			4					4				4		
	T	4					4					4			
Jun	R			4	1				5				5		
	T	5					5					5			
Jul	R			4					4				4		
	T	4					4					4			
Aug	R			4					3	1			4		
	T	4					4					4			
Sep	R			4	1				5				5		
	T	5					5					5			
Oct	R			4					4				4		
	T	4					4					4			
Nov	R			3					3				3		
	T	3					3					3			
Dec	R			2	3				4	1			5		
	T	5					5					5			
1985															
Jan	R			4					3				4		
	T	5					5					5			
Feb	R			3					1	2			3		
	T	3					3					3			
Mar	R			2	1				2	1			3		
	T	3					3					3			
Apr	R			4					4				4		
	T	5					5					5			
May	R			4					4				4		
	T	4					4					4			
Jun	R			3					4						
	T	4													
Jul	R			3					5						
	T	5													
Aug	R			3					3	1					
	T	4													
Sep	R			4					3				3		
	T	5					5					5			
Oct	R			5					5				5		
	T	5					5					5			
Nov	R			3	1				3	1			4		
	T	4					4					4			
Dec	R			1	1	1			1	2			3		
	T	3					3					3			

All results are for 100 ml samples.

R = Raw

T = Treated

(2302A/27H)

Table II-2

DRINKING WATER SURVEILLANCE PROGRAM DESERONTO WTP 1988

	WATER TREATMENT PLANT				DISTRIBUTION SYSTEM	
	RAW	TREATED	CARBON 1	CARBON 2	SITE 1	
					STANDING	FREE FLOW
BACTERIOLOGICAL						
AEROMONAS SP (0=ABSENT)			**DET'N LIMIT = N/A**	**GUIDELINE = 0 (A1)**		
JAN	.	.	0	0	.	.
	.	0	.	0	.	.
APR	.	.	0	.	.	.
JUN	.	.	0	0	.	.
JUL	.	.	.	0	.	.
AUG	.	1	0	0	.	.
E. COLI P/A (0=ABSENT)			**DET'N LIMIT = N/A**	**GUIDELINE = N/A**		
JAN	.	.	0	0	.	.
	.	0	.	0	.	.
APR	.	.	0	.	.	.
JUN	.	.	0	0	.	.
JUL	.	.	.	0	.	.
AUG	.	0	1	1	.	.
FECAL COLIFORM MF (CT/100ML)			**DET'N LIMIT = 0**	**GUIDELINE = 0 (A1)**		
JAN	0	.	.	.	.	.
	0	.	.	.	.	.
	1	.	.	.	.	.
MAR	0	.	.	.	.	.
APR	0	.	.	.	.	.
MAY	0	.	.	.	.	.
JUN	0	.	.	.	.	.
JUL	0	.	.	.	.	.
AUG	0	.	.	.	.	.
SEP	12	.	.	.	.	.
OCT	9 T48	.	.	.	.	.
NOV	5 T48	.	.	.	.	.
DEC	7 T48	.	.	.	.	.
FECAL COLIFORM (0=ABSENT)			**DET'N LIMIT = N/A**	**GUIDELINE = 0 (A1)**		
JAN	.	.	0	0	.	.
	.	0	.	0	.	.
APR	.	.	0	.	.	.
JUN	.	.	0	0	.	.
JUL	.	.	.	0	.	.
AUG	.	0	1	1	.	.

Note: Refer to Table III-1 for DWSP key to codes and abbreviations

Table II-2

DRINKING WATER SURVEILLANCE PROGRAM DESERONTO WTP 1988

	WATER TREATMENT PLANT			DISTRIBUTION SYSTEM		
SITE	RAW	TREATED	CARBON 1	CARBON 2	SITE 1	
TYPE					STANDING	FREE FLOW
STANDRD PLATE CNT MF (CT/ML)		DET'N LIMIT = 0		GUIDELINE = 500/ML (A1)		
JAN	190	123	.	.	.	1
	!AM	!AM	!AM	!AM	.	!AM
	93	24	.	24	.	.
MAR	79	5	.	.	.	2
APR	550	26	110	.	.	4
MAY	550	14	.	.	.	3
JUN	2400 >	2400 >	74	79	.	134
JUL	2400 >	129	480	340	.	38
AUG	!AM	!AM	!AM	!AM	.	!AM
SEP	.	43	480	520	.	1
OCT	.	12 T48	980 T48	670 T48	.	17 T24
NOV	.	0 <=>	210 T48	320 T48	.	0 <=>
DEC	.	0 <=>	18 T48	33 T48	.	2 <=>
P/A BOTTLE (0=ABSENT)		DET'N LIMIT = 0		GUIDELINE = 0 (A1*)		
JAN	.	0	.	.	.	0
	.	0	1	1	.	0
	.	1	.	1	.	.
MAR	.	0	.	.	.	0
APR	.	0	1	.	.	0
MAY	.	0	.	.	.	0
JUN	.	0	1	1	.	0
JUL	.	0	0	1	.	0
AUG	.	1	1	1	.	0
STAPH AUREUS (0=ABSENT)		DET'N LIMIT = N/A		GUIDELINE = 0 (A1)		
JAN	.	.	0	0	.	.
	.	0	.	0	.	.
APR	.	.	0	.	.	.
JUN	.	.	0	0	.	.
JUL	.	.	.	0	.	.
AUG	.	0	0	0	.	.
COLIFORM (0=ABSENT)		DET'N LIMIT = N/A		GUIDELINE = 0 (A1)		
JAN	.	.	1	1	.	.
	.	1	.	1	.	.
APR	.	.	1	.	.	.
JUN	.	.	1	1	.	.
JUL	.	.	.	1	.	.
AUG	.	0	1	1	.	.

Note: Refer to Table III-1 for DWSP key to codes and abbreviations

Table II-2

DRINKING WATER SURVEILLANCE PROGRAM DESERONTO WTP 1988

	WATER TREATMENT PLANT			DISTRIBUTION SYSTEM		
SITE TYPE	RAW	TREATED	CARBON 1	CARBON 2	SITE 1 STANDING	SITE 1 FREE FLOW
TOTAL COLIFORM MF (CT/100ML) — DET'N LIMIT = 0 — GUIDELINE = 5/100ML(A1)						
JAN	59 A3C	0	.	.	.	0
	53 A3C	0	4	3	.	0
	120	24	.	24	.	.
MAR	18 A3C	0	.	.	.	0
APR	1100	0	21	.	.	0
MAY	4 A3C	0	.	.	.	0
JUN	2 A3C	0	19 A3C	21	.	0
JUL	4 A3C	0	0	1	.	0
AUG	TOP	0	1 A3C	2 A3C	.	0
SEP	150 A3C	0	0	1	.	0
OCT	22 A3C	0 T48	36 A3C	24 T48	.	0 T24
NOV	44 A3C	0 T24	BDL	BDL	.	0 T24
DEC	52 T48	0 T48	0 T48	1 T48	.	0 T24
T COLIFORM BCKGRD MF (CT/100ML) — DET'N LIMIT = 0 — GUIDELINE = N/A						
JAN	780	0	.	.	.	0
	720	1	210	250	.	1
	840	5	.	5	.	.
MAR	1280	0	.	.	.	0
APR	3200	0	43	.	.	0
MAY	18000	0	.	.	.	0
JUN	60000	47	340	240	.	3
JUL	4800 >	1	280	260	.	0
AUG	40000 >	1500	880	1100	.	1600
SEP	10000	0	380	320	.	0
OCT	4800 >	0 T48	9600 >	216 T48	.	0 T24
NOV	9600 >	0 T24	BDL	20 T48	.	0 T24
DEC	1040 T48	0 T48	1 T48	1 T48	.	0 T24

Note: Refer to Table III-1 for DWSP key to codes and abbreviations

Appendix III

DESERONTO WATER TREATMENT PLANT
FLOW DATA

Table III-1
SUMMARY OF FLOWS FOR DESERONTO WTP FLOWS (ML/d)

Month	R/T	1987 Max.	1987 Min.	1987 Avg.	1986 Max.	1986 Min.	1986 Avg.	1985 Max.	1985 Min.	1985 Avg.
Jan	R	1.785	1.345	1.466	N	N	1.272	1.394	1.115	1.302
	T	1.599	1.188	1.310	1.400		1.213	1.278	1.067	1.191
Feb	R	1.493	1.202	1.288	N	N	1.033	1.986	1.106	1.410
	T	1.420	1.026	1.150	1.179		1.032	1.953	1.073	1.331
Mar	R	1.526	1.132	1.281	N	N	1.280	2.084	1.290	1.859
	T	1.389	1.016	1.143	1.250		1.172	2.086	1.121	1.756
Apr	R	1.474	1.125	1.235	N	N	1.113	1.375	1.179	1.246
	T	2.212	.830	1.274	1.138		.958	1.233	1.096	1.153
May	R	1.669	1.050	1.380	N	N	1.412	1.963	1.096	1.500
	T	1.151	.685	.938	.994		.907	1.890	.703	1.324
Jun	R	3.038	1.141	1.640	N	N	.562	1.801	1.029	1.306
	T	2.514	.346	1.177	1.301		1.171	1.507	.955	1.228
Jul	R	3.053	1.352	1.956	2.852	1.262	1.610	2.227	1.381	1.870
	T	2.769	.937	1.352	2.481	1.074	1.399	2.150	1.250	1.678
Aug	R	2.302	1.352	1.805	1.937	1.262	1.602	2.508	1.441	1.172
	T	1.735	.994	1.264	1.487	1.074	1.238	2.102	1.244	1.520
Sep	R	1.772	1.068	1.450	1.793	1.237	1.399	2.174	1.330	1.411
	T	1.457	.921	1.091	1.398	1.067	1.184	1.421	1.179	1.199
Oct	R	1.881	1.177	1.477	1.576	1.339	1.468	2.131	1.198	1.483
	T	1.316	.943	1.089	1.353	1.137	1.210	1.975	1.062	1.283
Nov	R	1.426	1.157	1.275	1.533	1.308	1.379	1.516	1.118	1.381
	T	1.140	.803	.982	1.528	1.165	1.229	1.364	1.073	1.251
Dec	R	1.441	1.200	1.299	1.610	1.208	1.368	1.332	1.104	1.201
	T	1.187	.942	1.037	1.537	1.036	1.270	1.191	1.054	1.136

R = Raw
T = Treated
N = No records

Appendix IV

DISINFECTION DATA FROM DESERONTO WATER TREATMENT PLANT

Table IV-1
DISINFECTION SUMMARY FOR DESERONTO WTP

onth	Chemical	1987 Pre- Max.	1987 Pre- Min.	1987 Pre- Avg.	1987 Post- Max.	1987 Post- Min.	1987 Post- Avg.	1986 Pre- Max.	1986 Pre- Min.	1986 Pre- Avg.	1986 Post- Max.	1986 Post- Min.	1986 Post- Avg.	1985 Pre- Max.	1985 Pre- Min.	1985 Pre- Avg.	1985 Post- Max.	1985 Post- Min.	1985 Post- Avg.
Jan	Cl_2 Demand																		
	Cl_2 Dosage				*	*	2.64	2.47	0.70	1.39	3.06	1.11	2.13	1.887	.347	1.02	3.065	.378	1.70
	NH_3																		
	SO_2																		
	Cl_2 Res. (Free)				1.5	.8	1.05	0.10	0.10	0.10	1.0	0.20	0.51	.3	.1	.12	1.0	.1	.57
eb	Cl_2 Demand																		
	Cl_2 Dosage				*	*	3.09	*	*	1.52	*	*	2.32	2.587	.735	1.240	4.169	.808	2.230
	NH_3																		
	SO_2																		
	Cl_2 Res. (Free)				1.5	.6	1.06	0.10	0.10	0.10	1.5	0.2	.66	1.0	.1	.150	1.0	.1	.52
lar	Cl_2 Demand																		
	Cl_2 Dosage				*	*	2.93	*	*	1.45	*	*	2.10	1.64	.709	1.09	2.661	1.268	1.89
	NH_3																		
	SO_2																		
	Cl_2 Res. (Free)				1.6	1	1.25	0.10	0.10	0.10	0.5	<0.1	0.4	.2	.1	.11	1.0	.10	.42
pr	Cl_2 Demand																		
	Cl_2 Dosage				2.69	1.01	1.82	*	*	1.40	*	*	2.08	1.508	.660	.969	3.428	.747	1.767
	NH_3																		
	SO_2																		
	Cl_2 Res. (Free)				1.4	.2	0.62	0.1	0.1	0.1	1.5	0.1	.58	.1	.1	.10	1.0	.1	.50

ote: Where no data is printed, data was not available
* Only monthly average dosage was calculated: total kg of chlorine used/total flow volume
Only free chlorine was measured at the WTP during this period.

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Table IV-1
Continued

Month	Chemical	1987						1986						1985					
		Pre-			Post-			Pre-			Post-			Pre-			Post-		
		Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.
May	Cl_2 Demand																		
	Cl_2 Dosage				2.65	.66	1.92	*	*	1.62	*	*	2.00	8.28	.462	.650	3.284	.337	2.110
	NH_3																		
	SO_2																		
	Cl_2 Res. (Free)				1.0	.1	0.43	0.10	0.10	0.10	1.5	0.70	0.90	.20	0	.07	1.5	0	.63
Jun	Cl_2 Demand																		
	Cl_2 Dosage				3.13	1.18	2.45	*	*	1.71	*	*	2.41	.881	.504	.680	3.077	.360	1.625
	NH_3																		
	SO_2																		
	Cl_2 Res. (Free)				1.2	.1	.84	0.10	0.10	0.10	2.5	0.4	.71	.3	0	0.06	1.5	0	.38
Jul	Cl_2 Demand																		
	Cl_2 Dosage				4.19	1.28	2.78	1.68	.64	.99	2.97	1.37	2.16	.657	.407	.492	3.684	.408	2.16
	NH_3																		
	SO_2																		
	Cl_2 Res. (Free)				1.0	.2	0.7	.1	.1	.1	.9	.1	.53	.3	0	.141	1.9	0	.50
Aug	Cl_2 Demand																		
	Cl_2 Dosage				4.27	1.98	3.204	2.7	.70	1.35	3.94	1.65	3.01	2.005	.415	.92	3.529	1.510	2.64
	NH_3																		
	SO_2																		
	Cl_2 Res. (Free)				1.0	.1	.758			.06	1.6	.60	1.02	.6	0	.14	1.5	0	.60

Note: Where no data is printed, data was not available
* Only monthly average dosage was calculated: total kg of chlorine used/total flow volume
Only free chlorine was measured at the WTP during this period.

Table IV-1
Continued

Month	Chemical	1987						1986						1985					
		Pre-			Post-			Pre-			Post-			Pre-			Post-		
		Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.
Sep	Cl_2 Demand																		
	Cl_2 Dosage				3.19	1.64	2.804				6.37	.89	3.21	1.915	.561	1.157	2.914	.710	1.969
	NH_3																		
	SO_2																		
	Cl_2 Res. (Free)				1.5	.5	0.965							.5	.1	0.2	.70	.10	.447
Oct	Cl_2 Demand																		
	Cl_2 Dosage				2.99	0.87	2.444				*	*	1.98	2.291	.482	1.452	3.060	.612	1.665
	NH_3																		
	SO_2																		
	Cl_2 Res. (Free)				1.5	.5	0.843				1.8	1.2	1.5	.20	0	0.1	1.7	.1	.685
Nov	Cl_2 Demand																		
	Cl_2 Dosage				2.73	0.78	2.034				*	*	2.81	2.338	.431	1.245	3.191	1.071	1.978
	NH_3																		
	SO_2																		
	Cl_2 Res. (Free)				1.0	.4	.764				1.8	.5	1.2	.1	.1	0.1	1.0	.50	.772
Dec	Cl_2 Demand																		
	Cl_2 Dosage				2.9	1.29	2.136				3.379	1.454	2.59	2.894	.732	1.286	2.541	1.176	1.937
	NH_3																		
	SO_2																		
	Cl_2 Res. (Free)				1.0	.5	.785				1.5	.8	1.23			.1	1.2	.4	.816

Note: Where no data is printed, data was not available
* Only monthly average dosage was calculated: total kg of chlorine used/total flow volume
Only free chlorine was measured at the WTP during this period.

Table IV-2

DISINFECTION PROFILE FOR DESERONTO WTP

	Pre-Chlorination							Post-Chlorination						
	Cl_2				Residual Cl_2			Cl_2				Residual Cl_2		
Date	Dem.	Dos.	NH_3	SO_2	Free	Comb.	Total	Dem.	Dos.	NH_3	SO_2	Free	Comb.	Total
Jan/87														
1									*					
2									*					
3									*					
4									*					
5									*					
6									*	.9				
7									*	.8				
8									*	.9				
9									*					
10									*	1.0				
11									*	1.0				
12									*	1.0				
13									*	1.0				
14									*	.48				
15	No Pre-chlorination								*	1.5				
16									*				1.1	
17									*					
18									*					
19									*					
20									*	1.2				
21									*	1.2				
22									*					
23									*					
24									*					
25									*					
26									*					
27									*	1.1				
28									*	1.0				
29									*	1.0				
30									*	1.1				
31									*					
									*					

Notes: Where no data is printed, data was not available

* Daily chlorine dosages were not calculated

Table IV-2
Continued

Date	Pre-Chlorination							Post-Chlorination						
	Cl_2				Residual Cl_2			Cl_2				Residual Cl_2		
	Dem.	Dos.	NH_3	SO_3	Free	Comb.	Total	Dem.	Dos.	NH_3	SO_3	Free	Comb.	Total
Mar/87														
1									*					
2									*					
3									*			1.0		
4									*			1.0		
5									*			1.5		
6									*					
7									*					
8									*					
9									*					
10									*			1.2		
11									*			1.2		
12									*			1.2		
13									*			1.1		
14									*			1.0		
15	No Pre-Chlorination								*					
16									*					
17									*			1.6		
18									*			1.3		
19									*			1.3		
20									*			1.2		
21									*			1.1		
22									*					
23									*					
24									*			1.5		
25									*			1.3		
26									*			1.4		
27									*			1.5		
28									*					
29									*					
30									*					
31									*					

Notes: Where no data is printed, data was not available

* Daily chlorine dosages were not calculated

Table IV-2
Continued

Date	Pre-Chlorination							Post-Chlorination						
	Cl_2				Residual Cl_2			Cl_2				Residual Cl_2		
	Dem.	Dos.	NH_3	SO_2	Free	Comb.	Total	Dem.	Dos.	NH_3	SO_2	Free	Comb.	Total
Jul/87														
1														
2									2.0					
3									1.3			0.6		
4									3.5			0.3		
5									3.5					
6									3.5					
7									3.0			0.2		
8									3.0			0.2		
9									7.7			0.3		
10									6.8			0.6		
11									2.2			0.4		
12									2.2					
13									2.2					
14									2.1			0.8		
15	No Pre-Chlorination								2.4			0.8		
16									2.2			0.8		
17									2.4			1.0		
18									2.7			1.0		
19									2.7					
20									2.7					
21									2.6			0.6		
22									2.4			0.5		
23									3.1			0.8		
24									2.4			0.5		
25									4.2			0.5		
26									4.2					
27									4.2					
28									2.6			0.6		
29									2.7			1.0		
30									2.7			1.0		
31									3.1			0.7		
									3.0			0.8		

Notes: Where no data is printed, data was not available

* Daily chlorine dosages were not calculated

Table IV-2
Continued

Date	Pre-Chlorination							Post-Chlorination						
	Cl_2				Residual Cl_2			Cl_2				Residual Cl_2		
	Dem.	Dos.	NH_3	SO_2	Free	Comb.	Total	Dem.	Dos.	NH_3	SO_2	Free	Comb.	Total
Oct/87														
1									3.0			.6		
2									2.3			1.0		
3									2.3					
4									2.3					
5									2.5			1.5		
6									2.1			0.8		
7									2.7			1.0		
8									2.7			0.8		
9									3.0			1.0		
10									3.0					
11									3.0					
12									2.7			0.8		
13									1.2			0.8		
14									1.1					
15	No Pre-Chlorination								2.4			0.8		
16									2.5			0.8		
17									2.5					
18									2.5					
19									2.6			0.8		
20									.87			1.0		
21									4.1			0.1		
22									1.62			0.8		
23									2.3			0.8		
24									2.3					
25									2.3					
26									2.2			0.8		
27									2.2			1.2		
28									2.4			1.1		
29									2.7			0.5		
30									2.3			0.7		
31									2.3					

Notes: Where no data is printed, data was not available

* Daily chlorine dosages were not calculated

Table IV-2
Continued

Date Jan/86	Pre-Chlorination Cl2 Dem.	Cl2 Dos.	NH3	SO2	Residual Cl2 Free	Comb.	Total	Post-Chlorination Cl2 Dem.	Cl2 Dos.	NH3	SO2	Residual Cl2 Free	Comb.	Total
1		0.93							1.75					
2		0.97							2.00			0.40		
3		0.81							1.87			0.40		
4		0.81							1.87					
5		0.81							1.87					
6		1.09							1.88			0.30		
7		0.73							3.06			0.30		
8		0.73							1.11			0.30		
9		0.70							1.83			0.20		
10		1.65							2.55			0.20		
11		1.65							2.55					
12		1.65							2.55					
13		2.47					0.10		1.5			1.00		
14		2.16					0.10		1.86			1.00		
15		1.47					0.10		1.90			1.00		
16		1.44							1.90			1.00		
17		1.44							2.10			1.00		
18		1.44							2.10					
19		1.32							1.48					
20		1.44							3.05			0.3		
21		0.38							1.99			0.3		
22		1.74							2.61			0.1		
23		1.77							2.76			0.2		
24		1.77							2.76			0.8		
25		1.77							2.56					
26		1.68							1.92					
27		1.84							2.25			0.5		
28		1.84							1.92			0.6		
29		1.78							1.89			0.6		
30		1.40							1.47			0.8		
31		1.85					0.10		2.47			1.0		

Notes: Where no data is printed, data was not available

* Daily chlorine dosages were not calculated

Table IV-2
Continued

Date	Pre-Chlorination							Post-Chlorination						
	Cl_2				Residual Cl_2			Cl_2				Residual Cl_2		
	Dem.	Dos.	NH_3	SO_2	Free	Comb.	Total	Dem.	Dos.	NH_3	SO_2	Free	Comb.	Total
Jul/86														
1		1.1							1.97					
2		1.4							2.25			0.55		
3		1.1					.10		1.88			0.40		
4		.7					.10		2.31			0.85		
5		.7							2.31					
6		.7							2.31					
7		1.0							1.83			0.40		
8		1.1							2.39			0.45		
9		.7							1.85			0.40		
10		.7							2.08			0.40		
11		.9							2.14			0.90		
12		.9							2.14					
13		.9							2.14					
14		1.0							2.28			0.85		
15		1.2							1.37					
16		1.3							2.12			0.90		
17		.9							1.68			0.55		
18		.9							1.43			0.40		
19		.9							1.43					
20		.9							1.43					
21		1.7					.10		1.53			0.20		
22		1.4							2.21			0.10		
23		.7							2.93			0.70		
24		1.4							2.64			0.40		
25		.8							2.80			0.60		
26		.8							2.80					
27		.8							2.80					
28		.9					.10		2.61			0.70		
29		.6					.10		1.37			0.55		
30		1.4							2.97					
31		1.0					.10		2.96			0.85		

Notes: Where no data is printed, data was not available

* Daily chlorine dosages were not calculated

Table IV-2
Continued

Date	Pre-Chlorination							Post-Chlorination						
	Cl_2				Residual Cl_2			Cl_2				Residual Cl_2		
	Dem.	Dos.	NH_3	SO_3	Free	Comb.	Total	Dem.	Dos.	NH_3	SO_3	Free	Comb.	Total
Oct/86														
1									*					
2									*			1.6		
3									*			1.6		
4									*			1.6		
5									*			1.6		
6									*			1.6		
7									*			1.6		
8									*			1.8		
9									*			1.5		
10									*			1.5		
11									*			1.5		
12									*					
13									*					
14									*					
15	No Pre-Chlorination								*			1.5		
16									*			1.5		
17									*			1.5		
18									*			1.5		
19									*			1.5		
20									*			1.5		
21									*			1.5		
22									*			1.5		
23									*			1.5		
24									*			1.5		
25									*			1.5		
26									*					
27									*					
28									*			1.5		
29									*			1.2		
30									*			1.4		
31									*			1.4		

Notes: Where no data is printed, data was not available

* Daily chlorine dosages were not calculated

Table IV-2
Continued

	Pre-Chlorination							Post-Chlorination						
	Cl_2				Residual Cl_2			Cl_2				Residual Cl_2		
Date	Dem.	Dos.	NH_3	SO_2	Free	Comb.	Total	Dem.	Dos.	NH_3	SO_2	Free	Comb.	Total
Jan/85														
1	1.6								2.3					
2	.8					.2			2.4			1.0		
3	1.9					.2			2.0			1.0		
4	1.1					.3			2.0			.8		
5	1.2								2.0					
6	1.2								2.0					
7	.8					.3			1.2			.7		
8	1.1					.1			2.3			.5		
9	.7								1.5			.5		
10	1.4								.7			.3		
11	.6								1.6			.3		
12	.6								1.6					
13	.6								1.6					
14	.7								3.1					
15	1.8					.1			2.2			1.0		
16	1.5					.2			2.5			1.0		
17	1.4					.2			2.0			1.0		
18	.3					.2			2.0			1.0		
19	.3								2.0					
20	.3								2.0					
21	.7					.1			1.1			1.0		
22	1.4					.1			.4			.50		
23	1.3					.2			.8			.10		
24	1.4					.1			1.6			.10		
25	1.4								.9			.30		
26	1.4								.9					
27	1.4								.9					
28	.8					.1			2.2			.10		
29	.7					.1			1.7			.70		
30	.7					.1			1.7			.50		
31	.7					.1			1.5			.10		

Notes: Where no data is printed, data was not available

* Daily chlorine dosages were not calculated

Table IV-2
Continued

	Pre-Chlorination							Post-Chlorination						
	Cl_2				Residual Cl_2			Cl_2				Residual Cl_2		
Date	Dem.	Dos.	NH_3	SO_2	Free	Comb.	Total	Dem.	Dos.	NH_3	SO_2	Free	Comb.	Total
Mar/85														
1		1.3					.10		1.3					.20
2		1.3							1.3					
3		1.3							1.3					
4		1.6					.10		2.5					.10
5		1.4					.10		2.2					.10
6		.90					.10		2.7					.10
7		1.4					.20		2.2					.7
8		.90					.10		2.2					.6
9		.90							2.2					
10		.90							2.2					
11		1.0					.10		2.0					.1
12		.9					.10		2.2					.2
13		.7					.10		1.7					.3
14		1.0					.10		2.4					.1
15		1.0					.10		1.8					.8
16		1.0							1.8					
17		1.0							1.8					
18		1.1					.10		1.6					.2
19		1.0					.20		1.5					.6
20		1.2					.20		1.5					.4
21		.9					.10		2.1					.2
22		.9					.10		1.7					.6
23		.9							1.7					
24		.9							1.7					
25		.9							2.5					.20
26		.9					.10		1.3					.50
27		1.0					.10		1.9					.40
28		1.4					.10		1.9					.40
29		1.4					.10		1.9					.30
30		1.4							1.9					
31		1.4							1.9					

Notes: Where no data is printed, data was not available

* Daily chlorine dosages were not calculated

Table IV-2
Continued ..

Date	Pre-Chlorination							Post-Chlorination						
	Cl_2				Residual Cl_2			Cl_2				Residual Cl_2		
	Dem.	Dos.	NH_3	SO_2	Free	Comb.	Total	Dem.	Dos.	NH_3	SO_2	Free	Comb.	Total
Jul/85														
1		.64							.8					
2		.4				.10			2.3			0		
3		.6				0			1.0			1.0		
4		.5				.20			1.2			0		
5		.5				.20			.4			.4		
6		.5							.4					
7		.5							.4					
8		.4				0			2.3			0		
9		.4				.20			1.2			.50		
10		.5				.20			2.3			0		
11		.5				0			1.4			.20		
12		.4				.20			2.0			0		
13		.4							2.0					
14		.4							1.0					
15		.7				.10			1.6			.20		
16		.7				.20			3.5			0		
17		.6				.20			3.2			.80		
18		.5				.20			2.8			.70		
19		.5				.20			2.6			.70		
20		.5							2.6					
21		.5							2.6					
22		.5				.20			3.5			.40		
23		.5				0			2.8			.80		
24		.5				1.0			3.0			.70		
25		.4				.20			3.5			1.50		
26		.5				.20			2.3			1.90		
27		.5							2.3					
28		.5							2.3					
29		.4				.20			1.3			.30		
30		.5				.10			3.7			.10		
31		.7				.30			3.7			.60		

Notes: Where no data is printed, data was not available

* Daily chlorine dosages were not calculated

Table IV-2
Continued

Date	Pre-Chlorination							Post-Chlorination						
	Cl_2				Residual Cl_2			Cl_2				Residual Cl_2		
	Dem.	Dos.	NH_3	SO_3	Free	Comb.	Total	Dem.	Dos.	NH_3	SO_3	Free	Comb.	Total
Oct/85														
1		1.8							1.3					
2		2.0							1.4					
3		1.8							1.3					
4		2.1					.05		1.2					.25
5		2.1							1.2					
6		2.1							1.2					
7		2.1					.20		2.4					.20
8		1.8					.10		2.7					1.5
9		2.3					.10		3.0					1.5
10		2.1					.20		3.1					1.7
11		1.9							1.6					1.0
12		1.9							1.6					
13		1.9							1.6					
14		1.9							1.6					
15		1.3					.10		1.6					.10
16		1.5					.10		.6					.10
17		1.8							.7					.10
18		1.0					.10		1.3					
19		1.0							1.3					
20		1.0							1.3					
21		.6							1.7					
22		1.2					.10		1.7					.20
23		1.3							1.8					.60
24		.6							1.9					.30
25		1.0							1.8					1.0
26		1.0							1.8					
27		1.0							1.8					
28		1.1					0		2.1					.10
29		.50					0		1.7					.80
30		.90					0		1.8					.60
31		.60					1.0		1.5					.80

Notes: Where no data is printed, data was not available

* Daily chlorine dosages were not calculated

Appendix V

JAR TESTING PROTOCOL

EXPERIMENTAL PROTOCOL FOR JAR TESTING

APPARATUS

The apparatus consisted of a Phipps & Bird, Inc. 6-place stirring apparatus. Two litre gator jars were used as the reaction vessels since they have been shown to provide a more realistic mixing environment than the usual 1 L round beakers which are commonly used in these types of evaluation. The root-mean-square velocity gradient was based on the calibration reported by Cornwell and Bishop (1983).

Final pH was determined using a Fisher Accumet 915 pH meter. Turbifity was measured using a Turner Designs Model 40 Nephelometer with a 2.0 NTU formazin standard. Total and dissolved organic carbon (TOC and DOC) were determined later by CANVIRO Analytical Laboratories. The organic carbon samples were preserved and stored in accordance with Standard Methods (1985).

REAGENTS

Alum - liquid alum from the Deseronto WTP was diluted to provide a stock solution containing 50 mg/L of $AL_2 (SO_4)_3 \cdot 14.2 H_2O$.

Polyelectrolyte - a prepared 0.15% solution of Aquafloc 6465 was obtained from the day tank at the Deseronto WTP.

Bentonite - a 5% solution was obtained from the day tank at the Odessa WTP. This was diluted to provide a stock solution of 5 mg/mL.

PROCEDURE

1. A 40 L grab samples was obtained from the raw water line to ensure that all of the trials used the same water.

2. Two litres of raw water was added to each gator jar. The gator jars were numbered according to the jar numbers in Table 1 and the treatment combination for the jar was noted on each jar.

3. The rapid mixing Gt was 36,000 (100 RPM for 360 s).

4. The flocculation Gt was 12,000 (30 RPM for 600 s).

5. Sedimentation time was 20 min.

6. The treatment combinations were chosen randomly and the appropriate jars were placed on the stirring apparatus. At the start of the experiment, all of the reagents were added as quickly as possible to the jars. The time span was approximately 90 s from the first to last jar.

7. At the end of the sedimental period, approximately 125 mL of sample were obtained for immediate turbidity and pH determinations. A further 250 mL were obtained for future TOC and DOC determinations.

8. During the flocculation and sedimentation periods, the jars were observed and the appearance of the floc was noted.

9. A qualitative evaluation of the strength of the various flocs was performed by simulating a hydraulic surge in the gator jars by briefly accelerating the stirrer to excite the settled flocs and then observing which ones settled the best afterwards.